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THE FOUNDRY

VOL. 17. DETROIT, MICH., DECEMBER, 1900. No. 100.

THE FOUNDRY PUBLISHING CO.
DETROIT, MICH.

JOHN A. PENTON, - - - EDITOR.

SUBSCRIPTION PRICE:

$1.00 a year in advance, postage prepaid in the United States, Canada and Mexico.
$1.75 a year to other countries, postage prepaid.
Single Copies, 15 Cents.

ADVERTISING RATES ARE PRINTED IN EACH ISSUE

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We want to obtain examples of current foundry practice. Photographs, drawings and descriptive matter, showing just what is being accomplished in the foundries of to-day, will be cheerfully paid for.

We can not furnish a continuous set of back numbers beyond August, 1900.

Entered at the Post Office at Detroit, Mich., as second-class matter.

Our First Century.

With the present issue is completed the one hundredth number of THE FOUNDRY.

A hundred months is a short time and yet how many of our readers can say that they have not witnessed great changes in that period.

Some say that molding is molding the world over and that foundry practice differs but little in one country from that of another. This is only partially true.

Every foundry uses sand and pig iron to make a casting, but what a difference in the manipulation of the materials.

One foundry will turn out three times the product per man that another shop will do.

And in the shop which turns out the least, the men may work the hardest.

Management becomes everything, other things being equal.

The best workmen in the world in the hands of someone, who has not got the ability to direct their efforts, become, as far as results are concerned, incompetents.

The demand in our foundries to-day is for men who can direct others.

Such men are always scarce and always will be.

The only way to become successful in the foundry business is to work and study persistently with that end in view.

In the past hundred months THE FOUNDRY has done its best to illustrate what the foundries are doing.

If you can adopt the good points of other shops' practice to your own you have been well paid for reading our columns from month to month.

The same identical plan of doing work will hardly ever fit in two foundries even if they are both doing the same class of work.

Some alteration is needed to make it slip into place. Here is where the shop manager's brains come into play. These we cannot furnish.

We will continue to show what the foundries of to-day are doing. Make the best use thereof.

Incidentally remember that there are others who would be glad to know what you are doing.

Help us make our next hundred issues better.

Trade Outlook.

For once, at least, the commercial solidity of the nation has had a determining voice in the electoral struggle. The result is too positive to be misunderstood and too overwhelming to be questioned. The determination to permit no interference with the present order of things is as marked as any political fact can possibly be.

The business end of the country, the wageworker as well as his employer, has said, in plain language, that sentimental politics must be made subordinate to the material well being of the majority. This decision is not made through noise and

hysteria, but represents the deliberate judgment of the electorate.

It is worthy of note, whatever personal opinion may be about the late election, that the result represents the enthusiastic desires of the business world.

Being so, there is every reason to expect that capital will be invested freely, developing new enterprises and carrying out policies of which it would have been timid had the result been otherwise.

This should not be taken to mean that indications point to a repetition of the boom times of '99, but a steady movement forward in all lines of manufacture.

The buyers of iron and steel evidently anticipated the result of the election, as a great increase in orders was placed in the two weeks immediately preceding it. This was undoubtedly done with the expectation of higher prices ruling afterwards through a simultaneous demand.

The blast furnace interests are not as hungry for business as they were a short time ago. Many sellers have secured all the orders they can fill for some time to come and are refusing to book new business except at advanced prices. Under such conditions further declines are exceedingly remote.

Taking it all together, the foundries have nothing to gain by withholding their orders. If anything, the chances are that those who fail to cover their wants now will have to do so at materially higher prices later.

Wages of British Molders.

A report has been issued by the labor department of the Board Trade, on the Standard Time Rate of Wages in the United Kingdom, for 1900. Taking first the rates of wages paid to iron founders for a full week's work, exclusive of overtime in the Barrow-in-Furness district in 1899, iron founders were paid weekly 31s. 6d.; 1890 to 1896, 34s.; 1897, 35s.; 1898, 36s.; 1899, 38s.; 1900, 39s. In the Birmingham district they received from 1889 to 1896, 36s.; 1897, 36s. to 38s.; 1898 to 1900, 38s. to 40s. In Bristol the rate in 1899 was 30s.; 1890 to 1896, 32s.; 1897 to 1899, 34s.; and 1900, 36s. In Cardiff and district the men were paid 2s. per week more than the Bristol men. Iron founders employed in the Leeds district in 1899 received 30s.; 1890, 32s.; 1891 to 1896, 34s.; 1897 to 1898, 36s.; 1899, 37s., and 1900, 38s. Liverpool iron founders have no reason to grumble at the wages paid them when compared with those paid in other districts. In 1889 they received 34s., which increased to 36s. in 1890, and again advanced a further 2s. for 1891 and 1892. From 1893 to 1896 there was a decrease in the amount paid them, they then receiving 36s. In 1897 they were paid 38s.; 1898, 38s. to 40s.; 1899, 39s. to 41s.; 1900, 40s. to 42s. The London iron founders' wages have been very good, 1889 to 1895, 38s.; 1896, 38s. to 40s.; 1897 to 1900, 40s. to 42s. In Manchester from 1889 to 1896, 38s. was the weekly wage; 1897, 39s.; and 1898 to 1900, 40s. Middlesborough men in the earlier years did not see such rosy times, for in 1889 they only received 33s. weekly. In 1890 the wages were advanced to 35s., at which figure they remained till 1894. In 1894 to 1896 the wages again went down to 33s., but since then there has been a steady advance, as will be seen. In 1897, 35s.; 1898, 36s. 6d.; 1899, 37s. 6d.; and 1900, 38s. 6d. Iron founders employed in the Newcastle-on-Tyne district have had their wages advanced and decreased, for in 1889 and 1890 they earned 34s.; 1891, 35s. 6d.; 1892, 36s.; 1893, 34s. 6d.; 1894 to 1896, 32s. 6d.; 1897, 34s. 6d.; 1898, 36s.; 1899, 37s.; and 1900, 38s. In Sheffield the rates of wages paid have been 1889 to 1890, 36s.; 1891 to 1898, 36s.; 1899, 39s.; and 1900, 40s. In the Warrington district the wages have been the same as those of Sheffield iron founders. At the works in the Swansea district iron founders in 1889 received 28s.; 1890 and 1891, 30s.; 1892 to 1899, 33s.; and 1900, 36s. In Wigan the wages were the same as those paid in Sheffield and Warrington up to 1897. In that year and 1898 Wigan iron founders were receiving from 38s. to 40s. per week. In 1899 the wages were increased to 39s. and 41s., at which figure they now stand.

Lucky Discovery.

Fire was discovered in the cupola at the Wing-Stephens Old Eagle foundry on Third and Commerce streets last night at 7:50. The fire department responded promptly and the fire was extinguished without any damage. The cause of the fire was the cupola becoming too hot.—Little Rock (Ark.) Gazette.

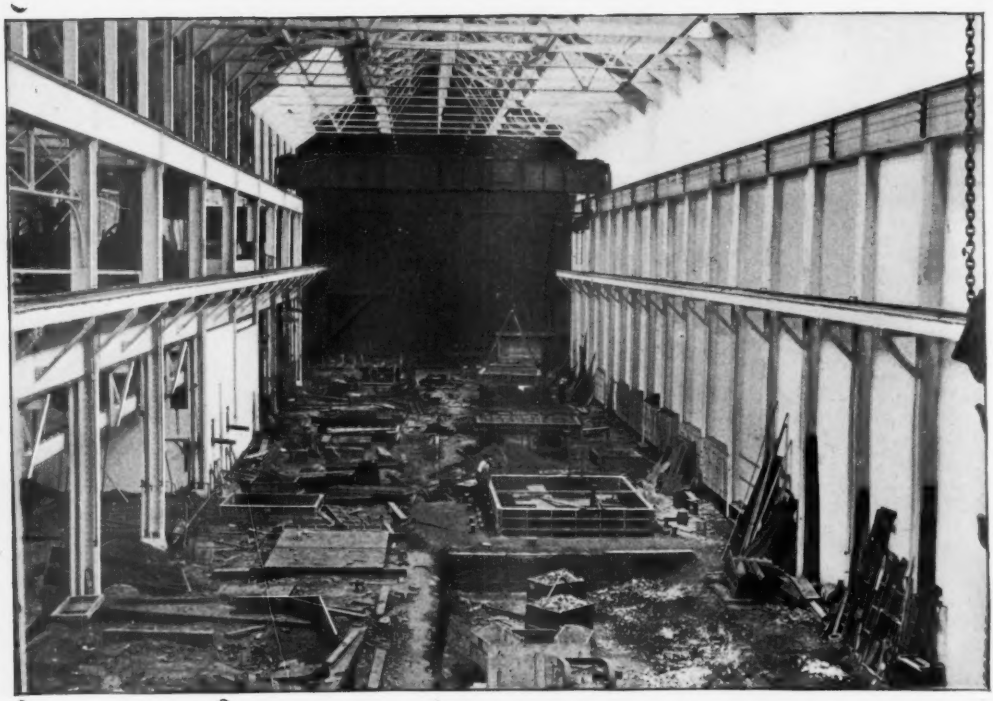
The Westinghouse Machine Company.

One must see Pittsburg and vicinity with his own eyes before he can fully realize the extent of the industries located in Allegheny County, Pennsylvania. For a number of years the iron and steel markets of the world have practically been ruled by this hilly city at the junction of the Mononahela and Allegheny rivers, which here join and form the historic Ohio.

Of the names connected with the development of Pittsburg's industries there are two which are known throughout the world as representing American energy and skill. One is Carnegie, the man who with efficient lieutenants has made iron and steel-making in the United States assume the first rank among the nations of the earth. The other name is that of Westinghouse, a name that appears on hundreds of thousands of railroad cars, electrical machinery, and engines.

The Westinghouse interests originally occupied quarters in the cities of Pittsburg and Allegheny, but the crowded condition of those places, together with the high value of factory sites there, if at all obtainable in large areas, has resulted in the works being transferred to the suburbs. Three years ago we illustrated the foundry of the Westinghouse Air Brake Company at Wilmerding, Pa. The foundry of the Westinghouse Electric and Manufacturing Company is yet located at Allegheny, although the main works are at East Pittsburg, Pa. (East Pittsburg is about thirteen miles from Pittsburg and is a separate town, having no connection with Pittsburg proper), as are also the works of the Westinghouse Machine Company, and it is to the foundry of the latter that we will devote the greater part of this article.

PLANT OF THE WESTINGHOUSE MACHINE COMPANY, EAST PITTSBURG, PA.



NEW ADDITION TO WESTINGHOUSE MACHINE COMPANY'S FOUNDRY.

86,000 POUND BEDPLATE FOR WESTINGHOUSE CORLISS ENGINE.

The name of the Westinghouse Machine Company ought in reality to be changed to the Westinghouse Engine Company, for it is a fact, probably not generally known, that this concern is one of the largest engine building establishments in the world. They are now turning out some engines having as high as 10,000 horse power capacity each.

All of the Westinghouse interests are noted not only for their products, but also for the up-to-dateness of their shop equipment and buildings, and the Westinghouse Machine Company's plant is no exception to this general rule. At the time the material for this article was procured, an addition to the foundry was very nearly completed, which will more than double the capacity of the foundry, the latter now being 600 feet long and 92 feet wide. It is served by five traveling cranes having a hoisting capacity of 140 tons, and is provided with five cupolas of the following diameters inside lining: One 36-inch, two 60-inch, and two new ones, 72-inch. In spite of these enlargements the company is yet compelled to operate a large foundry on the South side of Pittsburg, formerly the foundry of the Robinson-Rea Mfg. Co., and now known as the South Side Foundry of the Westinghouse Machine Company.

The first single acting high speed Westinghouse engine was patented in 1881 by Mr. H. H. Westinghouse, and the first engine was built for the purpose of driving a generator for a locomotive headlight. This engine was naturally of very small size and capacity, being about 1 horse power. The machine promised so well that a company was organized for the purpose of putting this engine on the market in larger sizes, and the Westinghouse Machine Company was incorporated in January, 1881, for the purpose of building this engine. The engines were built in the heart of the city of Pittsburg in the plant which had then just been vacated by the Westinghouse Air Brake Co., which had moved into a larger works. Since that time the business of the company has increased to such a point that it now has capacity to employ nearly 2,000 men. It has built upwards of 10,000 steam engines of sizes ranging between 5 horse power and 3,500 horse power. These engines are scattered all over the face of the globe and there is probably not a civilized country in the world where they are not in use.

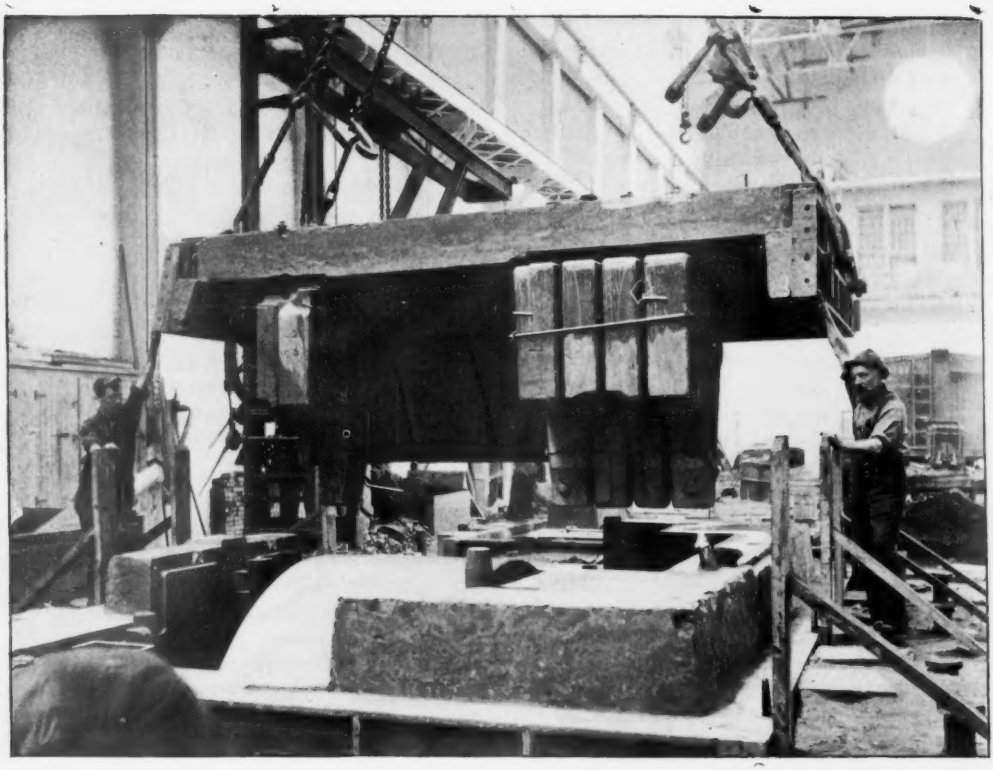
The company has for the last four years been building the Westinghouse gas engine in sizes ranging from 10 horse power to 700 horse power, the latter being probably the largest gas engine in the world, and certainly the largest ever built in this country. Upwards of 400 gas engines have been turned out at this works, the aggregate horse power of the same being about 28,000.

This company also builds, under license, the Parsons steam turbine engine and has just completed what is perhaps the largest engine of this class ever yet produced. This large turbine has an economical capacity for about 2,500 horse power, and runs at a speed of 1,200 revolutions per minute. These engines are certainly novel; they run beautifully, and are very economical.

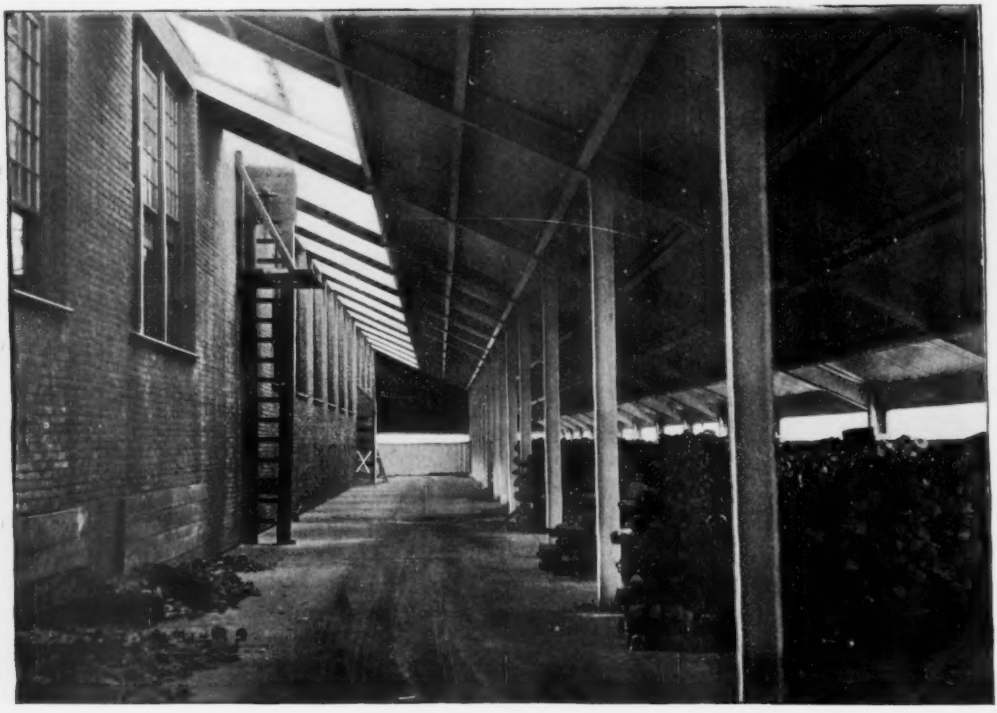
The Westinghouse Machine Company has within the past two years entered the field as builders of the largest size of steam engines in existence, and now has contracts for something like 125,000 horse power of the largest size Corliss engines under process of construction. The castings shown in the illustrations are those made for the Westinghouse Corliss engines, and will be recognized as the largest and heaviest of their types yet built. The bedplate shown weighed 86,000 pounds and is cast in one piece and finished on the planer in one setting. A special car must be employed in transporting this bedplate from the makers' shops to the City of New York, in which the major portion of these large engines are to be used.

The Corliss engine castings shown were produced at the South Side Foundry of the Westinghouse Machine Company. They are made from iron melted in air furnaces, and the average tensile strength of the iron in these castings, as taken from test bars made while pouring, will run about 35,000 pounds per square inch.

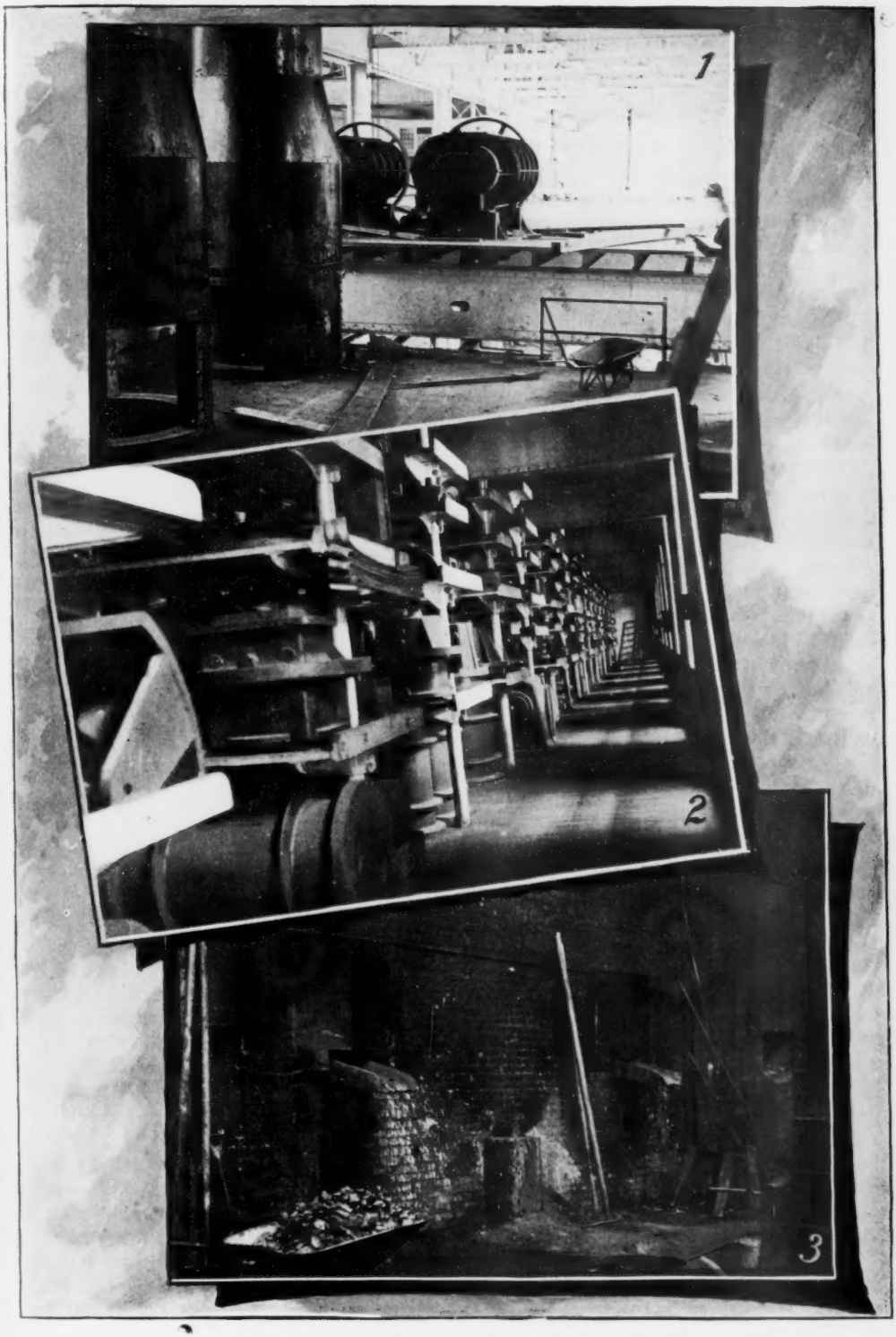
In the new addition to the foundry two new cupolas, 72 inches in diameter inside the lining, are located. These and the other cupolas in the older portion of the foundry are all reached by a pig iron storage building, built on a level with the charging floors and having a capacity of carrying ten thousand tons. A partial view of this is shown on page 144, and I am going to devote a paragraph or two to this and other features in its immediate vicinity, because I believe it offers an illustration of labor-saving as applied to



MOLD FOR LARGE BEDPLATE. A SECTION OF THE COPE WITH ITS CORES READY FOR LOWERING. NOTE METHOD OF SECURING THE CORES.



PIG IRON STORAGE BUILDING. CHARGING SCAFFOLDS OF ALL CUPOLAS ARE ON A LEVEL WITH THIS AND DIRECTLY TO THE LEFT. THE BOX LIKE OBJECT AT X, ENCLOSES ONE OF THE TWO COKE CONVEYORS.



1. PORTION OF CHARGING SCAFFOLD FOR NEW CUPOLAS. THESE HAVE DOUBLE CHARGING DOORS. 2. VIEW OF ONE OF THE FOUR FLOORS DEVOTED TO PATTERN STORAGE. 3. AROUND THE CUPOLAS. POURING BASIN IN THE CENTER LEADS TO PIG IRON BED IN THE REAR.

the handling of raw materials in a foundry.

Previous to building this structure for the storage of iron the ground space available for this purpose was very limited and a considerable distance from the cupolas, involving the handling of this material twice and by slow methods. As now arranged, side tracks enter immediately below and when a car of iron arrives its contents are loaded directly upon a car on a hydraulic hoist, and from the former is distributed to whatever position is assigned to that grade of iron. I should have said at the beginning that this structure is built of steel throughout, the floor being steel plates one-half inch in thickness. Besides the lasting qualities of this building it is also apparent that the general confusion, often witnessed, where pig iron is stored, is absolutely lacking.

Where such great quantities of iron are melted the handling of the fuel is another item which requires time and labor. In the foundry of the Westinghouse Machine Company two Link-Belt conveyers, one to each set of cupolas, are in use, and with their aid the coke is taken direct from the cars to the charging platforms. Some reader will probably say that all of these contrivances cost money, which is not to be denied, but when one stops to count the extra labor involved in handling fuel and iron at some of our large foundries by methods commonly in vogue, it is also plain that this will pay interest on quite a sum of money throughout the year.

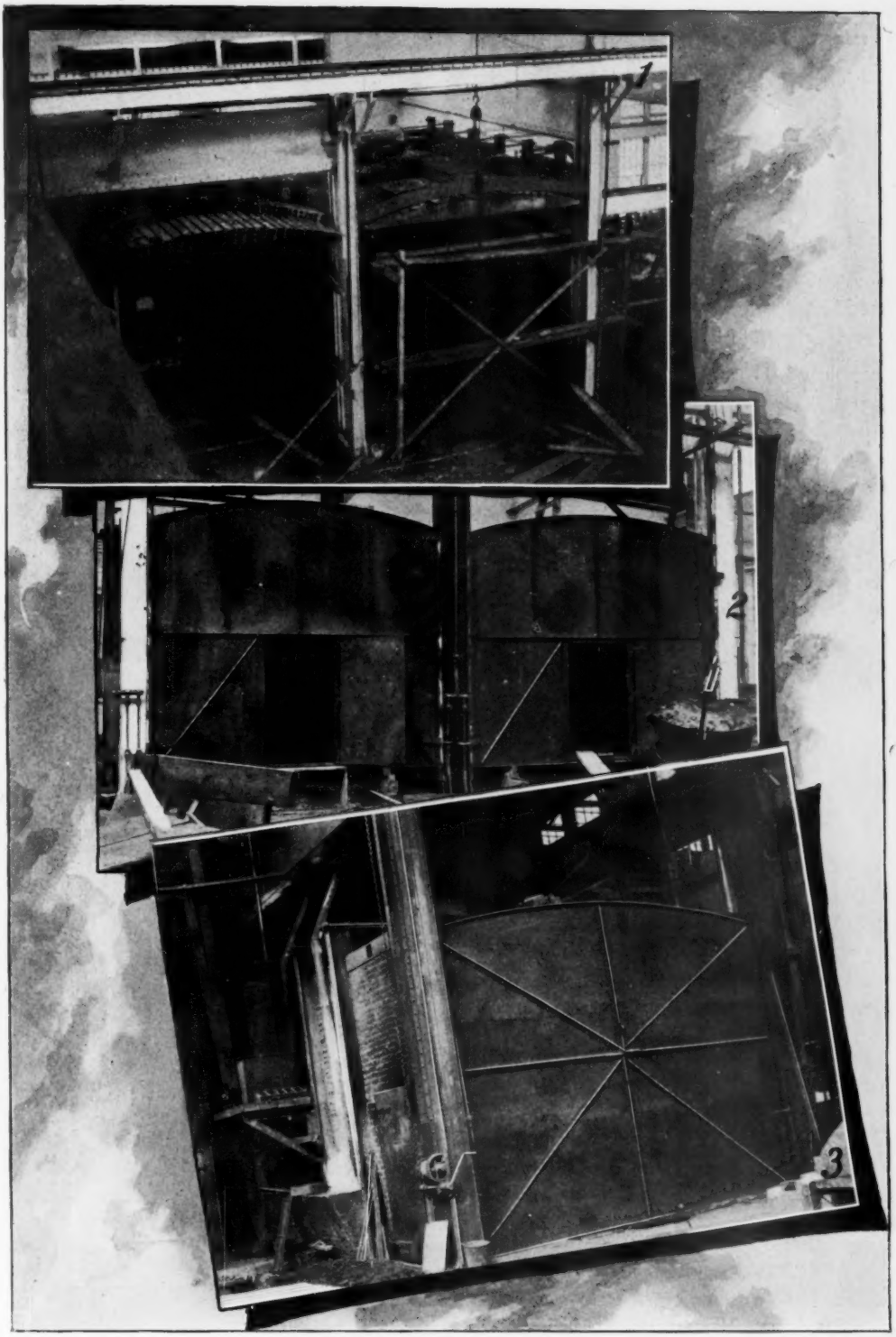
As said before, the cupolas in the Westinghouse Machine Company's foundry are located at two different points. I believe this is a good idea, and one which should be put into more universal practice. How often do we not find a couple or more large cupolas placed as close as possible to one another, with storage room not sufficient to operate one? Of course, the object is to make one charging scaffold do for the whole number; but does this pay? Is it not a fact that very often when the charges melt so rapidly in a set of cupolas that they cannot be properly weighed, that guesswork is resorted to by those who are supposed to keep the cupola loaded to the charging door?

Then take it down below, around the tapping spout, and is there not more or less excitement experienced in removing the metal when two or three cupolas pour forth their melted contents at the same time and place? Usually the shop will have more than sufficient crane capacity, but owing to the location of the cupolas this cannot all be brought into service. It is my firm conviction that the cupolas of a shop should be distributed at intervals. If it becomes necessary to keep all in operation, each can take care of a certain section of the shop. Should only the capacity of one cupola be required, the use of the one in the most central location would fill the bill.

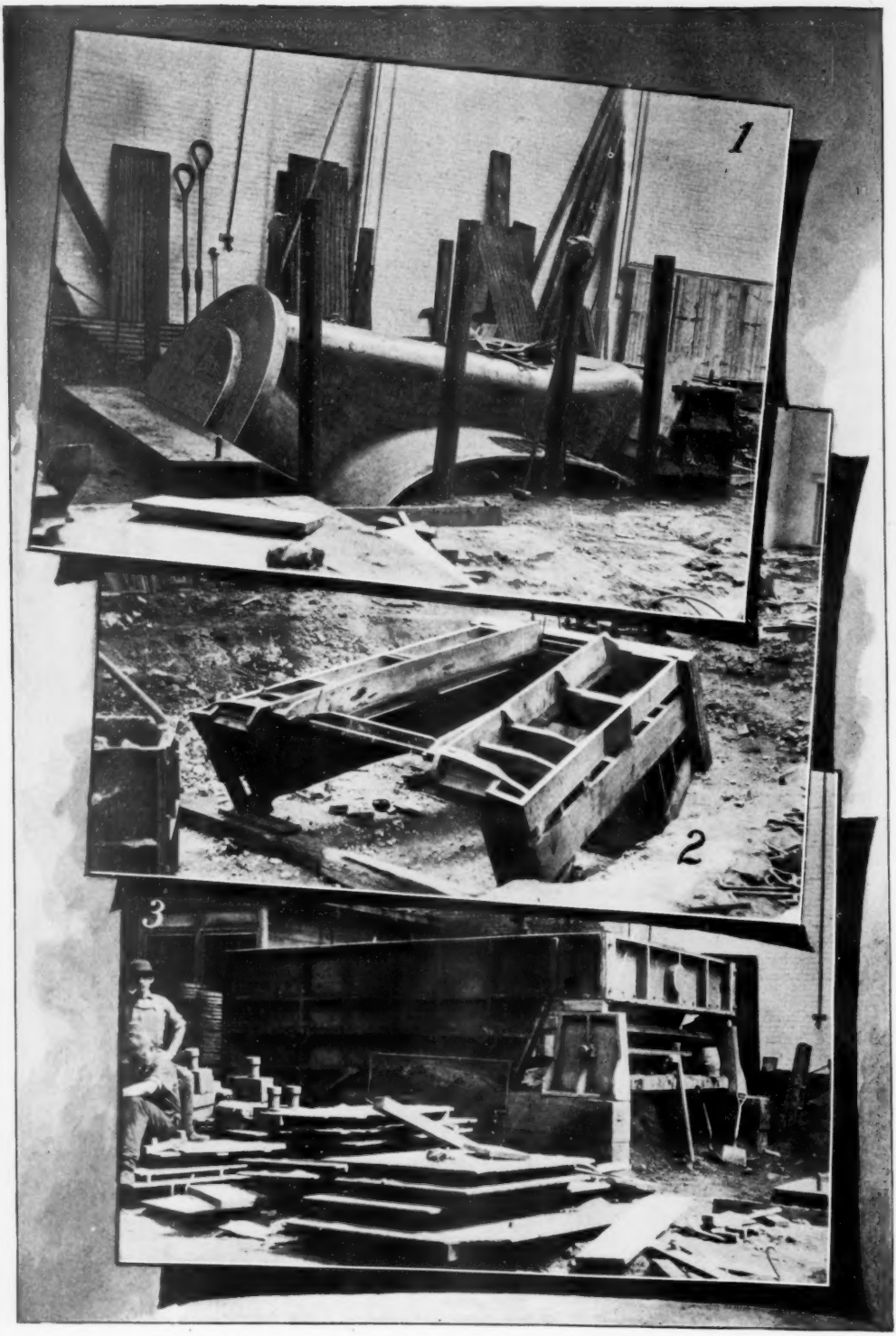
In foundries where large castings are made it becomes absolutely necessary at times to provide pig beds for considerable quantities of iron. Some of our technical friends may say that this should not have to be done, when figures will demonstrate very nearly just the quantity of iron required. At the same time it is usually better to have five tons of iron left in pouring a fifty-ton casting than to be five pounds short. The pig beds, as ordinarily made for an over-surplus of iron, are a nuisance in a shop, not only from the room they take up, but also on account of the heat they give off; a foundry commonly being blessed with an atmosphere more than hot enough at casting time. On page 145 will be seen a sort of pouring basin located between the two cupola spouts. This leads to a pig iron bed in the rear of the cupolas and the heat from same is consequently placed where it will prove of the least annoyance. This is a scheme worthy of being more generally adopted, as much on account of the added comfort resulting to the workingmen as for the extra labor it saves in the foundry proper.

The three illustrations on page 147 give a view of some core ovens in the foundry, completed and under construction. In the latter it will be noticed that the roofs are built of hollow bricks, thus combining lightness with strength, and well calculated to meet the requirements of varying temperatures. These core ovens are all heated by natural gas.

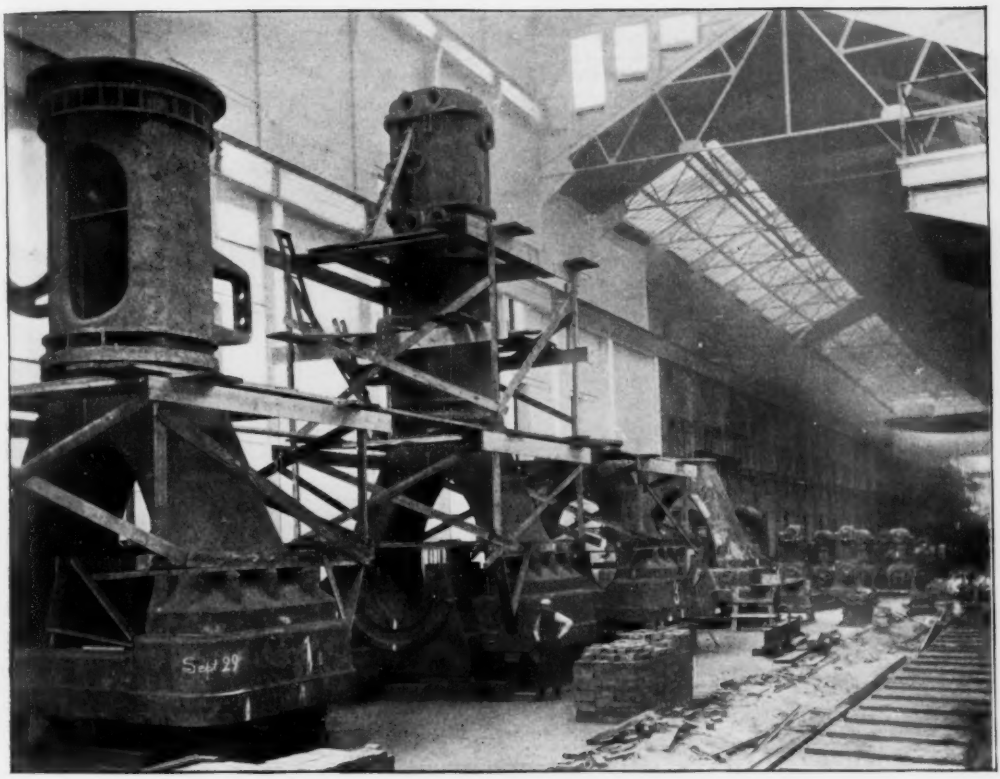
Along the walls of the foundry, in close proximity to one another, are placed connections leading to water and gas. Whenever a large cope has to be wet down a laborer does not have to hunt around for a bucket or sprinkling can to do this. Instead he attaches a rubber hose to the nearest water supply, and not only saves time but also does a better job. Of course, for wetting sand this system is also in the right place.



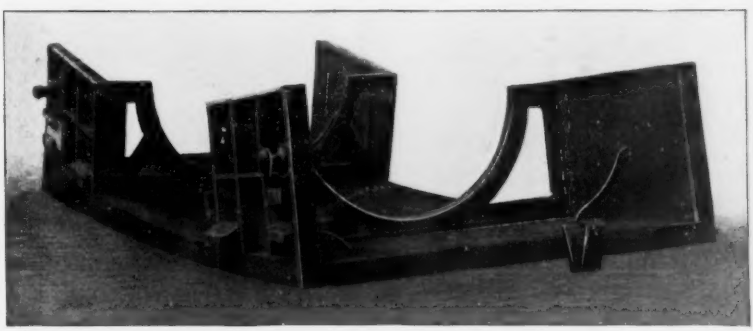
1. NEW CORE OVENS SHOWING ROOF CONSTRUCTION. 2 AND 3. THREE OTHER CORE OVENS.



1. DRAG PORTION OF MOLD FOR ENGINE FRAME. 2. FRAME FOR MAKING GREEN SAND CORE AFTER THE PATTERN IS DRAWN. 3. COPE PART OF FLASK



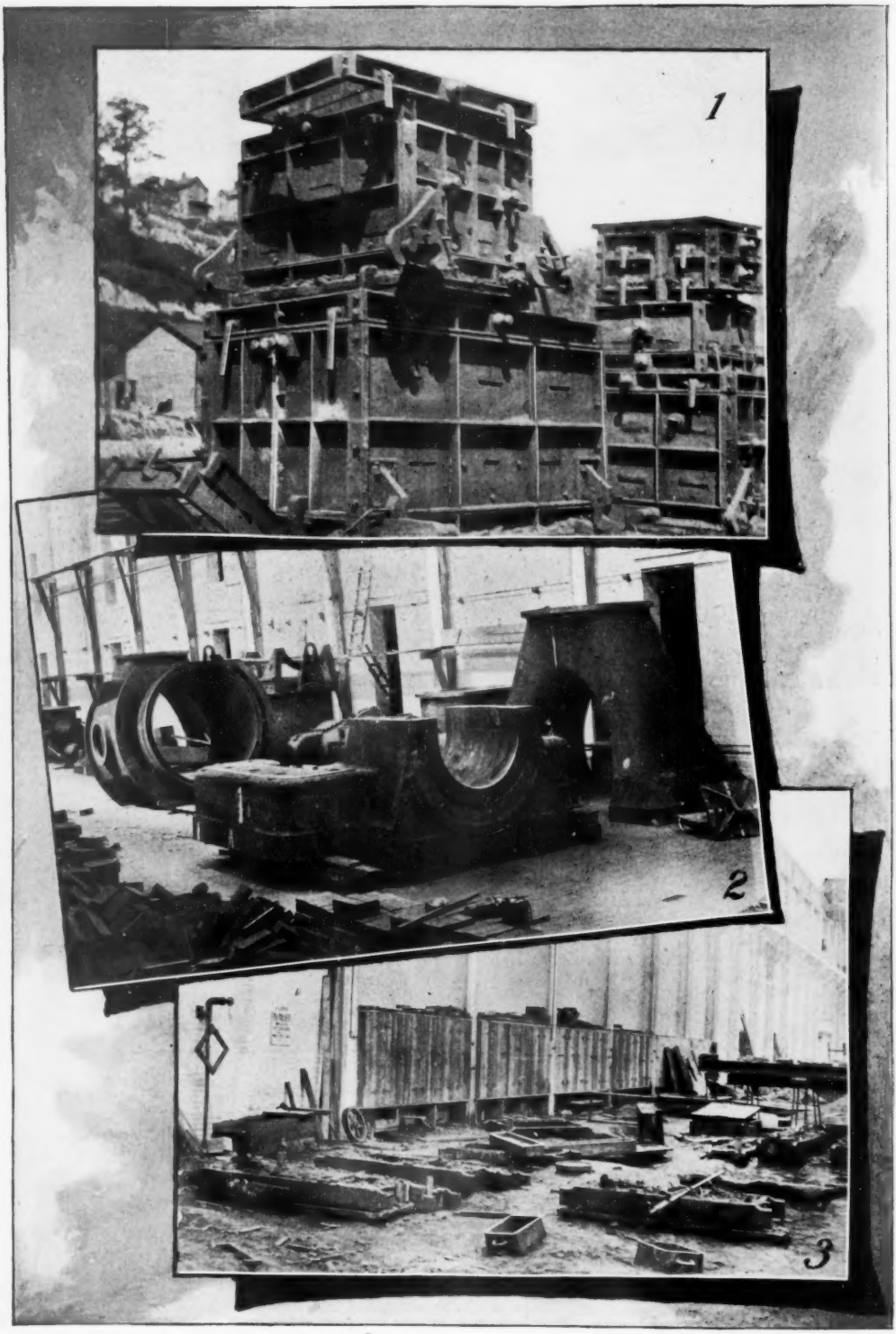
PART OF ERECTING SHOP. WESTINGHOUSE MACHINE CO.



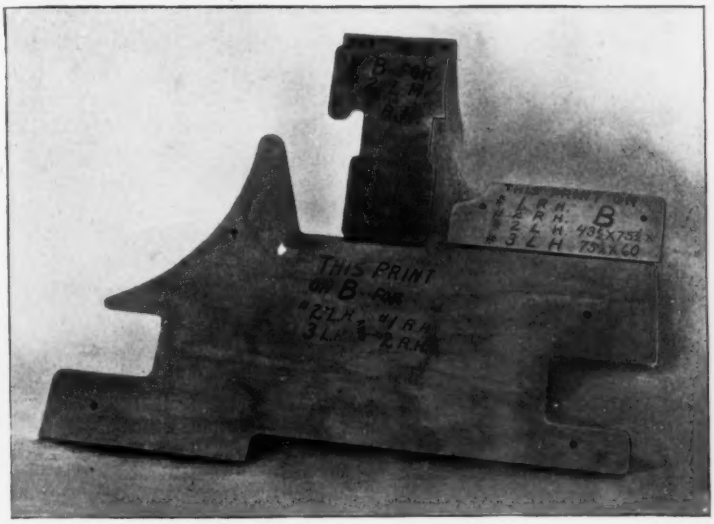
CHEEK PORTION OF FLASK FOR ENGINE BASE.

The foundryman who has never had the opportunity to use natural gas can hardly comprehend the great convenience of this fuel. Some time ago in visiting an Ohio foundry using natural gas, the foreman told the writer that he believed that in case the natural supply should fail he would install a plant for the manufacture of producer gas, rather than revert to the use of charcoal, coke, etc. Certain it is that for skin-drying molds, or parts of molds, where it is feared the swab has been used rather freely and left too great a moisture, nothing serves the purpose better than gas. A piece of rubber hose and a short section of gas pipe is all that is needed in the way of apparatus.

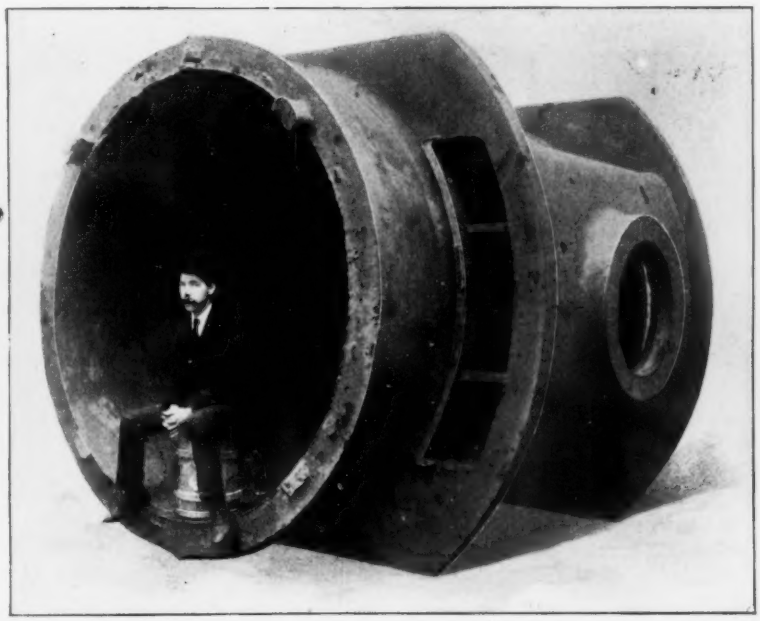
As the Westinghouse Machine Company only produces castings for its own use, all the rigging needed is of the most permanent character. This is seen on page 148, Fig. 1.



1. SOME EXAMPLES OF FLASK CONSTRUCTION. 2. A GROUP OF LARGE CASTINGS.
3. WORKMEN'S CLOSETS.



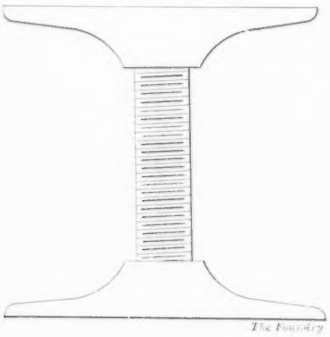
SYSTEM OF MARKING PATTERNS.



A LOW PRESSURE CYLINDER FOR WESTINGHOUSE CORLISS ENGINE.

The illustration to the right is a section of a Cylinder Casting as shown on this page and was made with the object of illustrating the benefits to be derived from the use of a large Sinking Head on that class of castings.

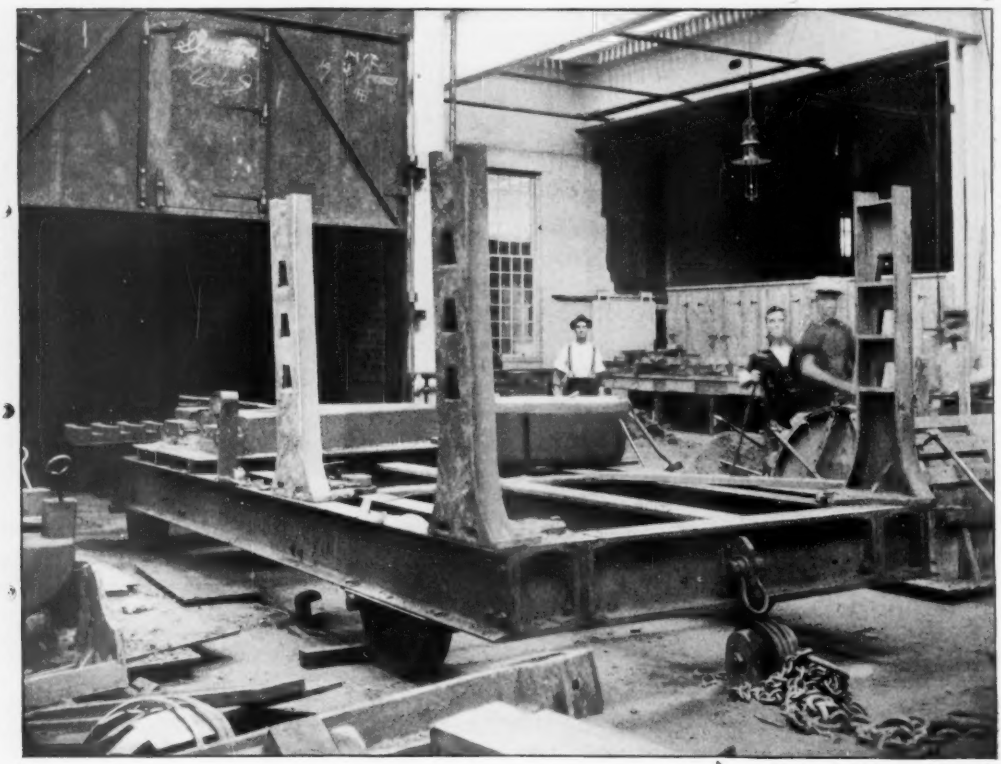
showing the drag portion of a mold for one-half of an engine frame bedded in the floor to about a line with the joint. Fig. 3 shows the cope portion of this flask, and



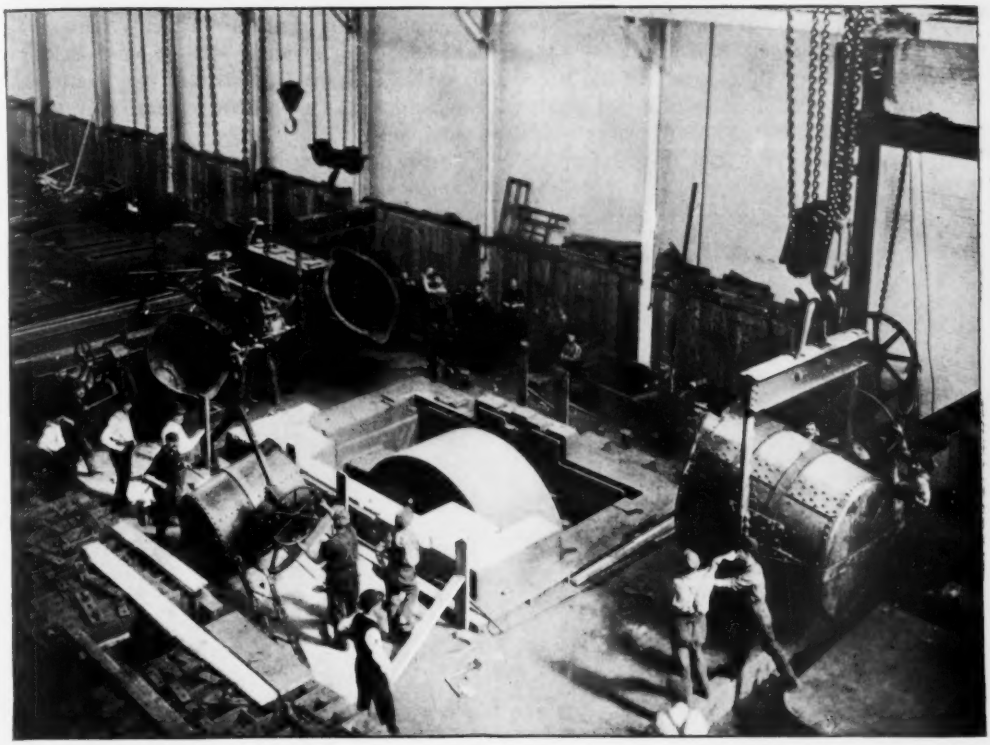
ADJUSTABLE CHAPLET STUD.

its substantial appearance and the general get-up of the whole outfit must appeal to the lovers of something solid to work with. The casting made in this flask weighs about twelve tons. The trunnions seen on the cope are solid steel cast into the sides of the flask.

Fig. 2 shows the core box, or rather the skeleton, by which the green sand core is made after the pattern is removed. There is one advantage in making cores by this method for large castings where possible, and this is that the casting will be truer to size than if made with ordinary cores. We all know that in spite of the best precautions a core will sometimes sag, when more or less dressing down has to be done, resulting in not only the consumption of extra labor, but also in the use of extra iron at points where this is not needed. A molder who knows his business will ram up a green sand core almost as quickly as a coremaker will make one ready for the oven, and leaving out the cost of flour and drying same, there is also in this case the advantage that there has to be no handling of the green sand core. Of course, a molder not acquainted with this class of work would be liable to have a few scabby spots on the casting, but then a concern making this class of castings has no business trying to make them with laborers, and it is very seldom attempted.



CORE OVEN CAR. WESTINGHOUSE MACHINE COMPANY.



A REHEARSAL AT THE WESTINGHOUSE MACHINE COMPANY'S FOUNDRY, PREVIOUS TO POURING A LARGE CASTING.

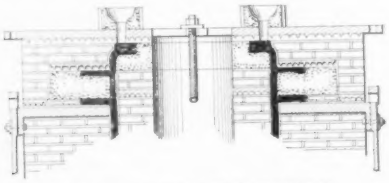
Another rather large flask is seen in the foreground of the illustration showing new addition. Its size can be approximately judged by that of the men standing alongside of same. This flask is intended for the molding of an engine base which will weigh about fifty tons. This is a good-sized job to be made in a flask, but the number to be made makes this method preferable to loam work.

Speaking of large castings made in green sand reminds me that the foundry of the Westinghouse Machine Company a long time ago earned and has always retained what might almost be called a national reputation in this line. Mr. H. H. Garrett (deceased, 1898), the veteran foundryman, who was the foreman for sixteen years in this shop, may properly be credited with a great many advances in foundry practice, and it is but natural that the results of his ingenuity should be found in the shop he served so long and well, and on a class of work to which he devoted a lifetime.

I have previously referred to the making of green sand cores directly in the mold. The base of the Westinghouse engine is made in this way, but as the top of the core is much larger than the bottom, it follows that no ordinary cheek could be employed. On pages 149 and 150 are shown some forms of flask construction which are of more than usual interest. The open flask seen is the cheek portion for one of these molds. When the pattern is withdrawn the cheek portion of the mold is divided perpendicularly and tilted through a special arrangement to each side, when the core box can be placed on the drag and the core rammed up. This style of flask is not only used for this particular job, but also where a drawback would have to be employed or cores used. In such cases only a portion of the flask is constructed in this manner.

On page 150 is seen a group of large castings turned out by the Westinghouse Machine Company's foundries. As is well known to the practical foundryman in this class of work, it often becomes necessary to resort to the use of chaplet studs, and on page

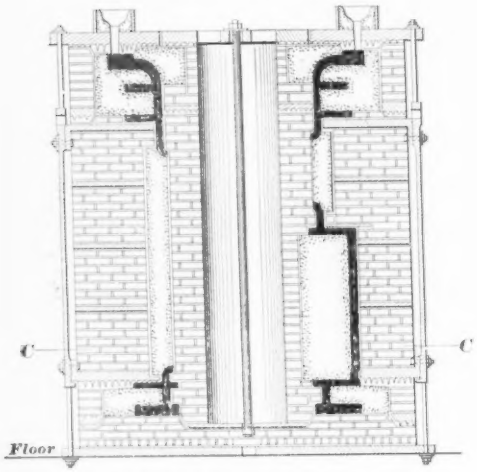
152 is shown a form of an adjustable stud. Cast iron studs are familiar to every molder of heavy work, who also knows that it is generally very difficult to find one which will give the exact thickness of metal wanted without resorting to the use of several small pieces of cast or sheet iron to make up the deficiency. With the adjustable stud shown the molder can easily and quickly make up a deficiency of one-half inch or less. Briefly described, the stud consists of two cast iron washers and a central stem, threaded throughout.



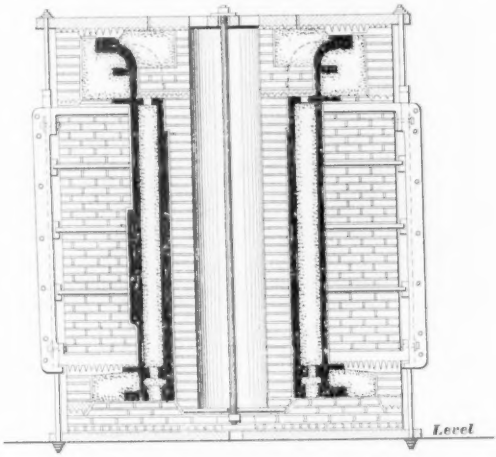
HIGH PRESSURE GUIDE

In the core oven car shown the axles have a roller bearing construction and the track on which it enters the oven is inclined so that the loaded car may with ease be pushed in by one or two men. The car is pulled out by the traveling crane hitched onto a chain running under a sheave as shown.

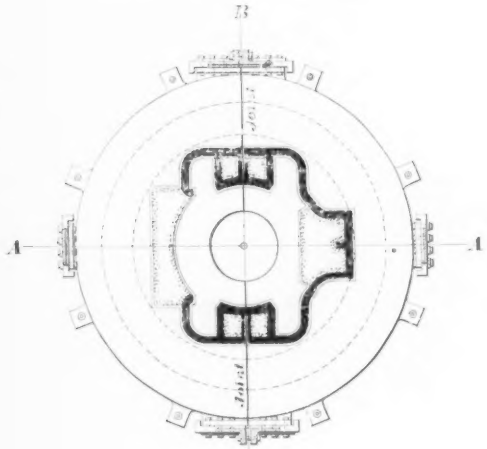
Our illustration, page 153, shows a rehearsal taking place in the foundry previous to the



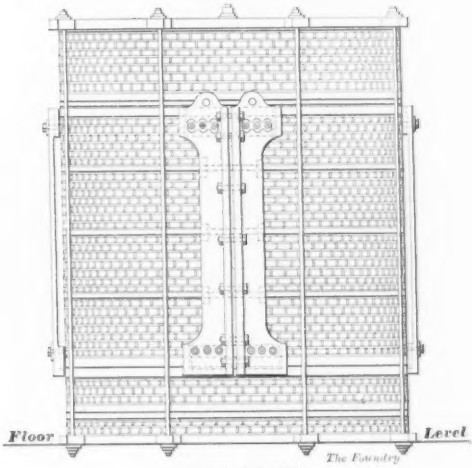
LOW PRESSURE GUIDE
Sectional Elevation through A-A



Sectional Elevation through B-B

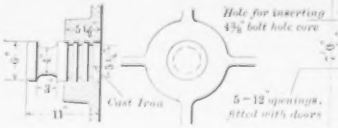


B
Sectional Plan through C-C

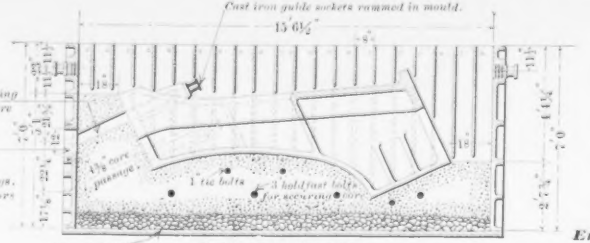


ELEVATION

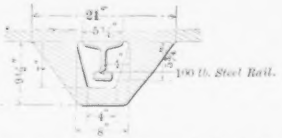
THE WESTINGHOUSE MACHINE COMPANY. DRAWINGS OF APPLIANCES FOR THE MOLDING OF LARGE CASTINGS.



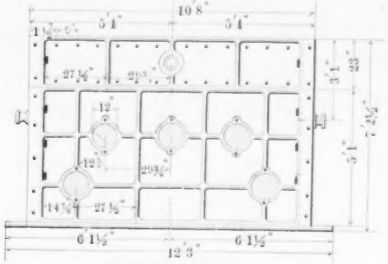
Enlarged detail of Wrought Iron Trunnion.


Cast iron guide sockets rammed in mould.
15'6½"
4¾" core passage
1" tie bolts
¾ holdfast bolts for securing cope
Bottom plate 2½" thick; perforated with vent holes.

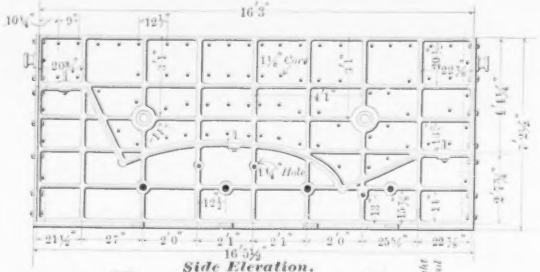
Sectional Elevation.



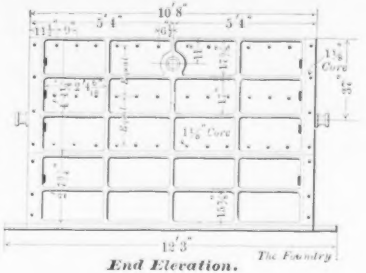
Enlarged detail of lugs on bottom plate for receiving side buckstays.



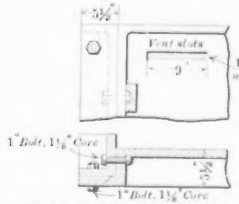
End Elevation.



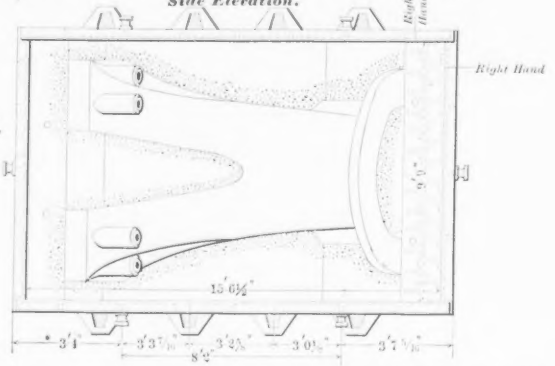
Side Elevation.

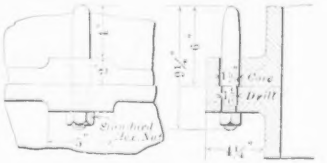


End Elevation.



Enlarged detail of vertical joints.





Enlarged detail of guide pins.

THE WESTINGHOUSE MACHINE COMPANY. DRAWINGS OF APPLIANCES FOR THE MOLDING OF LARGE CASTINGS.

pouring of a large casting. In this case four ladles had to be employed, and to insure that pouring spouts and everything else was in the right position, the ladles were hooked on to the cranes and tilted as they would be when filled with metal. Every man who is to take part in the pouring of this casting is thus fully instructed as to what is expected of him, and can be so instructed at length. When the critical moment of pouring arrives he needs no further orders. If more shops followed this plan there would be less of them getting "stuck" at a bad time.

In the majority of foundries the planning of methods for turning out large castings is left largely to the foundry foreman, who sometimes fails to understand exactly what the shape of the pattern is going to be and later finds that he must change his rigging. It will be of interest to our readers to know that the Westinghouse Machine Company follow a plan whereby guesswork is entirely eliminated.

Before work is commenced on the patterns a consultation is held between the superintendent, foreman of the pattern shop, and foreman of the foundry in which the particular work is to be done, and one of the company's engineers engaged in this class of work. The drawings are carefully explained to the foundry foreman, and in cases where necessary, models are employed to make everything perfectly clear. It is seldom that a foundry foreman is a good reader of intricate drawings, and the models serve admirably to enlighten him as to what is expected of him. Every phase of the procedure of making a mold for the piece is openly discussed, and this affords all parties in interest an opportunity of expressing their views freely. After a decision has been reached as to the best manner of molding the piece the pattern maker is instructed to make his pattern in accordance with this method, and the engineer and draughtsman proceed to carefully make a drawing of the mold, showing every joint and every brace, in fact, every detail of the mold complete. This affords an opportunity to calculate the strengths of the various elements of the flask and its fastenings and removes the problem wholly from the realm of guesswork which is generally employed on this problem. After the drawing is thus made additional conferences are held to confirm and, if necessary, modify any slight detail which further thought has enabled any one of the faculty to improve. This also affords the machine shop an opportunity to assist the foundry in making the best, simplest and strongest of rigging for binding and clamping the flask, as well as for lifting the casting or any part of the mold. It proceeds on the assumption that each one of the men above mentioned as participating in the conference has some particular qualification for making judgment that the others have not, and the result of this practice has been very gratifying to all parties concerned. It does not detract from the dignity of the foundry foreman to thus assist him in his work, but it compels him to think out every detail of the project carefully before he offers any finished suggestions as to a mode of procedure. The drawings on pages 154 and 155 show a brick mold in which is made the cross head guide for a Corliss engine and the flask in which the half housing is produced in green sand.

H. H.

CAST IRON NOTES.

Devoted to inquiries from Practical Foundrymen on the subject of Melting and using Cast Iron. Address all inquiries to W. J. KEEP, care of The Foundry.

A Hardness Test for Cast Iron.

QUESTION: What has become of the hardness test described by Mr. Chas. A. Bauer several years ago?

ANSWER: The machine that Mr. Bauer constructed has been in constant use and is a perfect success. By his test the hardness of a test bar is determined, and the iron mixture is changed to give the required hardness next day. I promised Mr. Bauer to make a machine for the market, but until very lately I found it difficult to construct a machine sufficiently sensitive to show that the degree of hardness indicates the amount of combined carbon in the iron.

The value of this discovery is to be of immense value to iron users.

The hardness of pig iron can now be determined in less than 15 minutes, before the car is unloaded, and absolutely without cost as no test bars are needed.

The iron can be piled according to its hardness, and a mixture can be made by hardness of pig iron, which will give the softest castings with little silicon and with great strength.

When castings are poured a test bar shows whether the castings are as soft as was expected.

It may be that the blast furnace will before long grade by hardness, and guarantee the hardness of each car of iron. The founder can then test each car before unloading as a check against mistakes. This will remove all uncertainty in making castings.

WHAT IS MALLEABLE CAST IRON?

QUESTION: What is malleable iron?

ANSWER: I presume you refer to malleable cast iron. These castings are made of white cast iron and are packed with oxide of iron in closed iron boxes, which are placed in annealing ovens.

They are slowly heated to a white heat and are then allowed to cool very slowly.

When the castings were put in they were hard and brittle, when they come out they are soft and malleable. The annealed castings are not at all like wrought iron, which is made by removing the impurities from cast iron. Chemical analysis shows the same amount of impurities after as before annealing except that before the carbon was all combined, and after, it is nearly all graphite. A gray cast iron having identically the same composition would have none of the characteristics of malleable iron.

FLUXING CUPOLAS.

QUESTION: Is there any improvement in the quality of the iron when flux is used in a cupola?

ANSWER: Flux is not used to improve the iron but to permit a large quantity of iron to be melted.

After a cupola has melted a certain quantity of iron slag will accumulate so as to interfere with the blast, and will become solid above the tuyeres, and prevent the iron settling to the melting point. Such a cupola is bunged up and will stop melting, and will not give a clean drop.

If you can melt all the iron you want, and the cupola is in good shape after the bottom is dropped, you do not need any flux.

If the iron melts good but the drop is not clean, a little limestone, or oyster shells, will prevent the slag from sticking to the sides of the cupola.

It is not well to make too much fluid slag if you do not tap it. If for any cause you are obliged to stop the blast, the slag will run into the tuyeres and you will find it difficult to start melting again.

If you wish to melt a large quantity of iron make a slag hole just under the tuyeres at the back of the cupola. After a few charges have melted draw off the slag just as you do iron at the front of the cupola.

The only way to make slag fluid enough to run out of the hole is to add limestone, oyster shells or fluor spar. When the slag runs freely you have used enough flux. The only harm there is in using more is the waste of flux and of fuel to melt it.

The iron in the hearth of the cupola is covered by a layer of liquid slag which protects it from the blast whether you use flux or not, and the drops of melted iron drop through this slag. It is not likely that the slag acts like a filter to purify the iron. While the iron lies on the cupola bottom any impurity will rise to the surface and unite with the slag, but any dirt or slag that is mixed with a drop of melted iron will probably go through the slag with the iron and separate afterwards.

Mixing Iron by Analysis.

BY W. G. SCOTT.

This article is a continuation of a contribution to the November issue of THE FOUNDRY, bearing the same title. The following specifications are those employed by the J. I. Case Threshing Machine Co., of Racine, Wis.

Specifications for Foundry Castings.

NO. 1.—SPECIAL HARD IRON. (CLOSE GRAINED.)

Designed for Air and Ammonia Compressors, High-Pressure Engine Cylinders, Valves, etc.

A CHEMICAL COMPOSITION.

Silicon must be between 1.20 and 1.60 per cent. (Below 1.20 the metal will be too hard to machine; above 1.60 it is liable to be porous unless much scrap be used.)

Sulphur must not exceed 0.095 per cent., and any casting showing an analysis 0.115 or more of sulphur will be the cause for rejectment of the entire mix. (Above 0.115 per cent., sulphur produces high shrinkage, shortness, and "brittle hard" iron.)

Phosphorus should be kept below 0.70 per cent., unless specified for special thin castings. (High phosphorus gives brittle castings, under impact.)

Manganese should not be above 0.70 per cent., except in special chilled work.

B. PHYSICAL REQUIREMENTS.

Transverse Breaking Strain, with load applied at the center and supports 12″ apart, on a square test bar 1″ square and 13⅓″ long, must stand a stress of not less than 2,400 lbs. All bars to be micrometered and figured to an exact square inch.

Deflection should not be less than 0.08″, when taken with a standard deflectometer.

Shrinkage, measured on a 13.333″ bar cast in a yoke, giving chilled ends, must not exceed 0.161″, after deducting one-tenth, so as to compute the shrinkage in 12″.

Chill, measured on the end of a test bar cast in a yoke, should not be more than 0.25″, except in chilled work where certain depth is required.

Tensile Strength of an extra test bar cast in sand, without the yoke, must not be less than 22,000 lbs.

The castings must be free from blow-holes, slag, dirt, shot, cinder, kish, and cold shuts.

A clean, close grained and strong iron is required for this class of work.

The mixture for this iron may be made from charcoal iron, low silicon foundry, home scrap, and steel scrap not to exceed 25 per cent., or wrought scrap not to exceed 10 per cent.

Enough scrap should be used so as to keep the graphitic carbon down low enough to produce a close grained iron.

Extra strength and greater chill may be obtained by adding from 1 to 10 lbs. of 80 per cent. Ferro-manganese to every 1,000 lbs. of the charge, but should not be added unless specified.

NO. 2.—MEDIUM IRON.

For Engine Cylinders, Gears, Pinions, etc.

A. CHEMICAL COMPOSITION.

Silicon to be between 1.40 and 2.00 per cent. (Silicon at 1.50 gives the best wearing result for gears.)

Sulphur must not exceed 0.085 per cent., and any casting showing on analysis 0.095 per cent. or more of sulphur will be the cause for rejectment of the entire mix. (Sulphur preferred at 0.075 to 0.080 per cent.)

Phosphorus should be kept below 0.70 per cent. except in special work.

Manganese should be below 0.70 unless otherwise specified.

B. PHYSICAL REQUIREMENTS.

Transverse Breaking Strain, as described under No. 1 iron, must not be less than 2,200 lbs.

Deflection not less than 0.09″.

Shrinkage on test bar cast in yoke must not exceed 0.151″.

Chill should be below 0.15″.

Tensile Strength of a test bar cast in sand must be above 20,000 lbs.

The iron must be free from blow holes, shrink cavities, slag, kish, shot, cold shuts, blisters, etc.

This mixture may be made with Nos. 1, 2 or 3 foundry pig, home or foreign scrap. Total scrap should not be over 50 per cent. For safety, in a 50 per cent. mix the foreign scrap should be figured at 0.100 per cent. for sulphur.

NO. 3.—SOFT IRON.

For Pulleys, Small Castings, and general agricultural implement work.

A. CHEMICAL COMPOSITION.

Silicon must not be less than 2.20 or more than 2.80 per cent., with a preference for about 2.40. (Below 2.20 per cent. small castings will be very hard; above 2.80 large castings will be somewhat weak and have an open grain.)

Sulphur in no case must exceed 0.085 per cent. (If above 0.095 the whole lot will be condemned.) High sulphur makes iron "brittle short," and causes excessive shrinkage.

For frictional wear in brake shoes, etc., the sulphur may run up to 0.150 per cent.

Phosphorus should be kept below 0.70 per cent., except in cases where great fluidity is required, as in thin stove plate, when it may run up to 1.25 per cent. (Phosphorus makes iron brittle under impact.)

Manganese should be kept below 0.70 per cent., except in chilled work. (Manganese toughens iron, produces chill, and causes some shrinkage.) For a heavy chill the manganese may vary from 0.70 to 1.25 per cent.

B. PHYSICAL REQUIREMENTS.

Transverse Breaking Strain must not be under 2,000 lbs.

Deflection should not be under 0.10″.

Shrinkage must in no case be above 0.141″, when figured to a 12″ bar, this being equivalent to one-eighth of an inch to the foot on castings molded in sand.

Chill should be under 0.05″.

Tensile Strength on a sand cast bar must not be below 18,000 lbs.

The iron must be free from defects, such as blow holes, shot, blister, cold shuts, slag, shrink cavities, kish, contraction cracks, etc.

Misplaced cores, poor moulding and insufficient cleaning will also be cause for rejectment.

This mixture may be made from Nos. 1 and 2 foundry pig, home and foreign scrap.

Scrap should be used in sufficient quantity to prevent formation of "kish" and to obtain the desired strength. It should run from 30 to 50 per cent., being governed by the sulphur. Equal parts, or 15 per cent. home with 30 per cent. foreign scrap is a good proportion to use. Scrap or re-melted iron gives strength to castings by reducing the graphitic carbon and closing the grain.

In mixing by analysis it is better to figure foreign scrap at 0.100 per cent. sulphur.

When the sulphur in the castings rises above 0.081 per cent. the per cent. of scrap should be reduced in the next mix in order to regulate the sulphur. With low sulphur (0.071 per cent. about) 50 per cent. of scrap may be used.

No. 298—Specifications for Molding Sand.

Sand purchased under this specification must be reasonably free from stones, dirt, silt, and organic matter, such as roots, decomposed vegetables, etc.

Three kinds of sand will be considered, viz: Silica or Fire Sand; Molding Sand; and Core Sand; these sands will be classified according to their chemical composition, and graded according to the degree of fineness into five distinct grades or numbers as follows:

Grade.	Degree of Fineness.
No. 1.—Superfine.....	above 100 per cent.
No. 2.—Fine or Light.....	100 to 90 " "
No. 3.—Medium	90 to 75 " "
No. 4.—Coarse or Heavy.....	75 to 55 " "
No. 5.—Extra Coarse	55 to 30 " "

In specifying the fineness of sand, the above numbers will be used, and will apply to silica, molding, and core sand.

No sand will be accepted which varies more than 5.00 per cent from the grade designated at the time of purchase.

Silica or Fire Sand.—This material is used for refractory work, tempering high bond molding sand, mixing with fire clay, for steel casting purposes, and for grinding.

Good fire sand will usually run about 98.00 per cent of silica, with very little alumina, lime, magnesia or combined water, and not more than a mere trace of iron.

No fire sand will be accepted which shows on analysis, less than 95.00 per cent of silica, more than 4.00 per cent of alumina, or more than 1.00 per cent of lime.

The following analysis of an average fire sand will give some idea as to what is desired.

Silica	SiO_2	98.04 per cent.
Alumina	Al_2O_3	1.40 "
Iron	Fe_2O_3	.06 "
Lime	CaO	.20 "
Magnesia	MgO	.16 "
Combined Water	H_2O	.14 "
Specific Gravity		2.592

Molding Sand.—Molding sand for iron work generally contains from 75.00 to 85.00 per cent of silica, 5.00 per cent to 13.00 per cent of alumina, usually less than 2.50 per cent of lime and magnesia, not over 0.75 per cent of fixed alkali (soda and potash), generally less than 5.00 per cent of iron, and seldom more than 4.00 per cent of combined water.

Sand for brass molding may contain a much higher percentage of iron and lime, without doing any particular harm.

All molding sands usually contain some organic matter, generally present in the form of small roots or as decomposed vegetable matter.

We do not expect to buy a sand with an exact chemical composition, as this is almost an impossibility, the same bed of sand often varying several per cent in silica and alumina at different places; we do, however, reserve the right to reject any sand not of the required degree of fineness, or that contains an excessive amount of carbonate of lime, magnesia, iron, and organic matter. Our limit for the objectional elements is as follows:

Carbonate of lime must not exceed 1.50 per cent in an iron molding sand, and should not exceed 2.25 per cent. in a brass sand.

Iron must not exceed 5.50 per cent in the iron molding sand, or 7.00 per cent in a brass sand.

Organic matter must not exceed 1.00 per cent and preference will be given sands running lower in organic matter.

Clay and silt are objectionable, consequently any sand showing on analysis more than 13.00 per cent of alumina will be rejected. (See note.)

The following analyses of molding sand will give some idea as to their chemical composition.

		Light Iron Work.	Med. Iron Work.	H'vy Iron Work.	Light Brass Work.
Silica	SiO_2 =	82.21	85.85	88.40	78.86
Alumina	Al_2O_3 =	9.48	8.27	6.30	7.89
Iron Oxide	Fe_2O_3 =	4.25	2.32	2.00	5.45
Lime Oxide	CaO =		.50	.78	.50
Lime Carbonate	$CaCO_3$ =	.68	.29		1.46
Magnesia	MgO =	.32	.81	.50	1.18
Soda	Na_2O =	.09	.10		.13
Potash	K_2O =	.05	.03		.09
Manganese	MnO =		trace	.25	trace
Combined Water	H_2O =	2.64	1.68	1.73	3.80
Organic Matter	=	.28	.15	.04	.64
Specific Gravity	=	2.652	2.645	2.630	2.640
Degree of Fineness	=	85.18	66.01	46.86	94.88

So far as the chemical composition is concerned, any one of the above sands would answer fairly well for nearly any class of work, but it is absolutely necessary that the proper degree of fineness be carefully considered.

Core Sand.—The quality, or chemical composition of a core sand, according to some authorities, is of minor importance, the degree of fineness being the main feature.

As a rule, a good core sand should be high in silica and low in alumina.

The bond for core sand is obtained by adding rosin, flour, etc., consequently the desired effect it produced with a high silica sand, or with a sand low in alumina and iron.

A sand low in alumina and iron will permit of the rapid escape of the gases, whereas a high alumina or a clay-sand bakes and holds back the gases.

The two following analyses, although radically different, are good core sands, due entirely to low alumina and iron.

		Extra Quali y Core Sand.	Fair Quality Core Sand.
Silica	SiO_2 =	94.30	69.31
Alumina	Al_2O_3 =	1.95	4.76
Iron Oxide	Fe_2O_3 =	.33	1.58
Lime Carbonate	$CaCO_3$ =	1.63	3.50
Lime Sulphate	$CaSO_4$ =		8.19
Magnesia	MgO =	.54	7.77
Alkalies	Na_2O, K_2O	.05	.12
Combined Water	H_2O =	1.05	2.95
Organic Matter	=	.15	1.82

Objection will be made to core sands containing more than 5.00 per cent of alumina, or more than 2.50 per cent of iron.

When a shipment of sand is received, the inspector will select three samples of about two pounds each, from different parts of the car, and these samples will be sent to the laboratory for examination.

The sand after being thoroughly mixed by machinery, will first be weighed, then dried at a temperature of 220° Fahr. for one hour, or until perfectly free from moisture; the difference or loss in weight, of the moist sand and the dry sample will represent the amount of moisture present.

The degree of fineness and the chemical analysis are to be determined on the dry sample. The apparatus required for estimating the percent or degrees of fineness, consists of a scale or balance sensitive to one centigram or a tenth of a grain, and a set of five inch U. S. Standard brass sieves of the following mesh, viz: 100, 80, 60, 40 and 20 mesh.

These sieves are fitted with a cover and a bottom pan, and may be used separately or in combination; they may be obtained of any dealer in chemical apparatus.

METHOD OF DETERMINING THE DEGREE OF FINENESS.

Weigh out exactly 100 grams of the dry sand (or if preferred weigh out 1,000 grains).

Place the bottom pan on the 100 mesh sieve, then empty the weighed sand into the sieve and put on the cover.

Now shake the sieve for exactly one minute, shaking sidewise mostly, but occasionally up and down to free the meshes of sand; at the end of one minute remove the bottom pan and weigh the sand that passes through, and credit the amount of sand that passed through to the 100 mesh sieve.

Now place the bottom pan on the 80 mesh sieve, empty into this the sand remaining on the 100 mesh sieve, and clean the sieve with a stiff stencil brush so as to get all of the sand out of the meshes.

Now put the cover on the 80 mesh sieve and shake for exactly one minute as before, then weigh the sand on the bottom pan, i. e., the amount that passed through, and credit to the 80 mesh.

Repeat the operation on the 60, 40 and 20 mesh sieves, crediting each sieve with its respective weight.

The amount of sand passing through the sieve, multiplied by the number of the mesh, and the sum of the several results divided by 100, will give the average per cent or degree of fineness of the sample.

Usually there is a small loss, due to dust and to small particles of sand remaining in the meshes.

Using a set of sieves as described above, the average mesh of the series will be 60,

consequently any loss sustained should be multiplied by this figure and added to the total amount.

In case there should be some coarse material remaining on the 20-mesh sieve it is to be weighed and credited to a No. 1 mesh.

The following example will more clearly illustrate the method and calculations.

Weight of Sand passing through.			Number or Mesh of Sieve.			
55.22	grams,	multiplied by	100	mesh	=	5522.00
20.89	"	" "	80	"	=	1671.20
11.64	"	" "	60	"	=	698.40
10.57	"	" "	40	"	=	422.80
1.20	"	" "	20	"	=	24.00
.06	"	" "	1	"	=	.06
99.58						
.42	(loss)	" "	60	"	=	25.20
						8363.66

8363.66 divided by 100. = 83.64 per cent. which is assumed to be the correct degree of fineness.

In cases of dispute it is customary to make duplicate determinations of the degree of fineness, and take the average as an absolute figure.

If the test is carefully carried out there should be very little loss, and duplicate determinations should not vary more than two per cent.

Note.—The following remarks on the effect of certain elements in sand will give some idea as to what is desired, and to what is considered objectional.

Silica is the fire resisting element; it has no bond, i. e., binding property, consequently in a sand where adhesiveness is required, alumnia must be present; silica alone is very refractory, but in the presence of the fluxing elements, iron, lime, magnesia, soda and potash it readily fuses and forms silicates; these silicates fuse or melt at about the following temperatures.

Silicate of Alumina	melts at 4350° Fahr.
Silicate of Magnesia	melts at 3960° Fahr.
Silicate of Lime	melts at 3810° Fahr.
Silicate of Iron	melts at 3270° Fahr.
Silicate of Soda	melts at 1500° Fahr.

When soda or potash is present, silicates are formed at low temperatures.

Iron melts at 2200° to 2300° Fahr., consequently a sand containing much iron, lime and alkali will burn or fuse into the molten metal, when molding, or in other words, the more lime or alkali present the more easily the sand is converted into a slag.

Alumina is the binder, hence a sand high in alumina is said to be strong or possess "bond;" alumina is very refractory, but unlike silica, it "bakes together" like pottery at a high temperature, consequently too much alumina must not be present in sand, otherwise the mold would be spoiled by excessive shrinkage or by the sand being non-porous.

Lime may exist in sand as oxide, hydrate, carbonate or as sulphate, occasionally in two different forms, but usually as carbonate and oxide; the carbonate is the most objectional form, as on heating, the carbonic acid gas is driven off, producing an excess of gas and reducing the original volume of sand.

Most of the lime salts are converted into oxide on burning, consequently excess of lime will cause a mold to either drop or crumble.

Iron may be present as ferrous oxide, ferric oxide, hydroxide, or as ferrous carbonate, all of which are converted into ferric oxide by heat. Iron in the presence of silica, alumina, lime, magnesia, etc., has a tendency to fuse or produce a slag by reduction.

Manganese in sand acts in a similar manner to iron, but not in such an energetic manner on account of its high fusion point.

Magnesia is very similar to lime, but less harmful on account of being more refractory.

Organic matter gives bond to sand, but the bond or binding property is destroyed the moment it comes in contact with the molten metal, the organic matter being burned out; consequently there is a loss in volume and this shrinkage causes the sand to fall or crumble.

Combined water is always present in high alumina sands, and is one reason for the shrinkage in a strong bonded sand.

The sand purchased under this specification must be within the specified limits in regard to iron, lime, and organic matter.

In buying sand, particular attention will be paid to the degree of fineness; the sand will be designated by number and must correspond to the proper degree of fineness; thus, for example, if a No. 3 Molding Sand is ordered, the degree of fineness must be between 75. and 90. per cent.

Specifications for castings made from steel, malleable iron, brass, etc., will be printed in a following issue.

As before mentioned, a specification answers a double purpose and may be used in the purchasing of goods, or merely as an index to determine the dividing line between good and bad material.

The pig iron specification belongs to the former class and is used exclusively for the purpose intended.

The only rigid feature in this specification is in regard to sulphur. We have, however, experienced no trouble in getting even lower sulphur than the points specified.

If desired, the purchasing agent may, under the head of "Remarks," change the specified per cents., and make any allowance he thinks proper; he is, however, responsible for all such alterations.

When pig iron is sold on specification and accepted, that settles the matter and the seller never hears from it again. On the other hand, in foundries that do not purchase their iron in this way, if the castings are bad, the party selling the iron is immediately informed that his iron is no good, whereas the iron may not be at all to blame, and the real trouble probably be due to poor fuel, the scrap, or to melting conditions.

In less than five years all pig irons will be sold by analysis and on specification.

The second class of specifications, such for instance, as molding sand, are used in a different manner. In this case we ask for samples of sand from the various dealers and, after making an analysis the samples are marked and graded according to our specification.

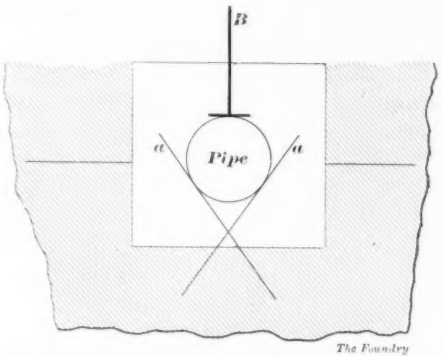
The foundryman selects the sand he desires to use and the purchasing agent incloses with his order our specification designating the grade coinciding with the sand ordered; in this way there is no chance for substitution and uniformity of grade is assured.

Answer to D. H. R.

Some years ago the writer had considerable experience on a job similar to, though smaller than that mentioned by D. H. R. in the October number of THE FOUNDRY.

The cause of honeycombing is that the iron will not lay to the pipe. We tried plumbago, also heating the pipe and rubbing it while hot with resin, but the result was the same, poor. We then ground the pipe on an emery wheel until it was bright and clean, and our castings came solid, none cast on the clean pipe being honeycombed.

The cause of the pipe shifting from its anchors is plain. The pipe becomes so heated before the mold is filled and iron "set," that it bends from its own weight. To remedy this we set anchors in the drag, as shown in cut; thus preventing pipe from sagging or shifting sidewise, and over these



A.—Anchors in Drag. B.—Chaplet in Cope.

a chaplet to prevent raising, anchors being about 12 inches apart. In this way we made castings by the hundred, and had no difficulty.

THOMAS L. AUSTIN.

A correspondent of a contemporary, discussing the same subject as Mr. Austin, says that if the wrought iron or steel upon which iron is to be cast be clean, and shall not be in any measure fused in the process, the casting will be perfectly solid, not a sign of honeycomb appearing. Of course, all foundrymen know better than to pour molten iron upon a rusty piece of wrought or steel, or upon rusty cast iron, either. Molten iron exhibits the most extreme antipathy to oxide of iron, and whenever they come into contact an explosion results. The great trouble is that oxide exists where it is least suspected. As soon as a piece of cold steel is laid in a mold oxide begins to form. The steel must therefore be hermetically sealed with something that will prevent atmospheric contact. What causes formation of oxide is condensation. The steel is either colder or warmer than the air within the mold; it is impossible to maintain them at an equal temperature, for the reason that steel is a greater conductor of heat or cold than sand. This matter can be easily tested. Just lay a piece of steel in a mold, close it and an hour or two later open the mold and examine the steel. It will be as wet as if you had immersed it in water. But this is not all; the surface of the steel will have an invisible coat of oxide, sufficient to cause violent

chemical action when the melted iron touches it. The water might do no harm, especially if the casting were of thick section, for it would be quickly evaporated by the intense heat from the inflowing iron. But you cannot wet a piece of steel and evaporate the moisture without producing oxide; and here is where the mischief lies, in one respect.

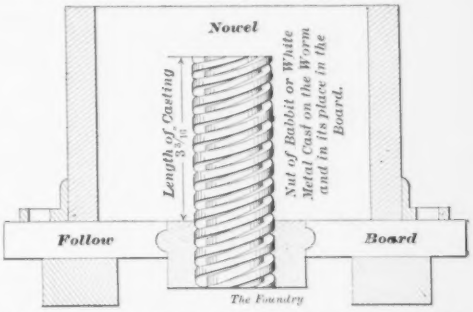
I say in one respect; for, if the steel be melted, in contact with the iron, though ever so little, a gas will be generated, the effect of which will be to produce cavities in the casting. If the steel be fused sufficiently to cause it to weld to the iron, then enough gas will be generated to cause honeycomb. If we coat the steel with silicate of soda (sometimes called "water glass") no oxidation can ensue. But this will not prevent fusion. What, then, shall be done? Well, that depends. Some people have good success by coating the steel with oil, and then covering it with sharp sand. Others merely paint with red lead, and find that it answers the purpose. In heavy castings, however, it may be necessary to pour the iron so cold as to prevent possibility of fusion.

Gate the mold so that the iron shall not flow against the steel. If, while the mold is filling, the iron flows over the piece of wrought iron or steel, it will greatly increase the liability to fusion. A coating of oil is sometimes sufficient to prevent all trouble. Finally, no matter what method may be employed, remember these two points—no rust, no fusion.

Casting a Double-Thread Worm.

Some time since a sketch was published, with a description of a method followed in molding a double-threaded worm with a pattern separated longitudinally. In that case it was found that upon drawing the pattern from the sand, the tendency was for the pattern to travel endwise. In order to draw the pattern a block of wood was rammed up at the end of each half of the pattern, and by drawing out the block first a space was left, so when the half pattern was gently tipped, bringing the joint face upright, the pattern had traveled some 1¼ inches into the space left by drawing out the block, and when the half pattern was so elevated it would come out easily.

I enclose a sketch showing a method of molding a double-threaded worm to be cast vertically, and, of course, without joint seams. There is but one pattern, with nut, here sketched to show the method, but in


Nowel
Length of Casting 3 5/16
Nut of Babbit or White Metal Cast on the Worm and in its place in the Board.
Follow
Board
The Foundry

CASTING WORMS FROM SOLID PATTERN.

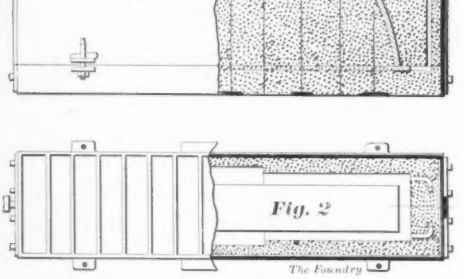
actual use there were four patterns in a flask. Nothing could produce better results than the method followed, as the castings can testify. There was a treatment given these patterns at each molding that seemed to be somewhat singular. They were of iron, and the most successful way to clean and prepare them was to oil them well with crude petroleum, then wipe perfectly clean and dry with clean waste. Kerosene oil, beeswax and other devices were diligently tried, but the first mentioned method was most successful.

The work of molding was very carefully done, fine sand being evenly and not too firmly tucked around the patterns, so that the threads would not be too hard or uneven in firmness. The nowel was cautiously and evenly rammed up with rammers, stricken off and the bottom board carefully rubbed on. Then the nowel was turned over. A wire, so bent as to fit into two holes drilled into the top end of each pattern, was then inserted and the patterns steadily unscrewed out of the nuts, and when all were unscrewed and the follow board, removed, the nowel was placed in position upon the floor for pouring. Then the cope was rammed upon a true, plain-surfaced board, with spots showing where the patterns were located to enable the molder to place his pouring gates in right position. They were gated sometimes with horn gates and one center pouring gate, and some were poured with single gates punched through the cope right on top. The cope when finished was closed on to the nowel. There was no fault to be found with the castings.—L. C. Jewett, in American Machinist.

Molding a Grindstone Trough.

A grindstone trough is one of the castings which very soon pay for a special molding box. When made as shown in Figs. 1 and 2, the pattern is complete in itself, no core boxes being used, no chaplets being required to support the cores, and no ugly joints whatever marking the resulting casting.

Fig. 1



The flask is a three-parted one, 6 ft. by 20 in. by 4 ft. deep, consisting of drag, middle, and top parts. A guide is bolted on to each end of the box, its length being greater than the highest portion of the semi-circular core, to enable the middle part to be parted off without danger to the above-mentioned core. Figs. 3 and 4 show end views of the box with the guide arrangement.

In molding this piece of work the drag is first rammed up and strickled off to the

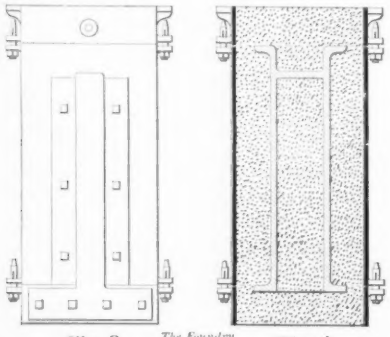
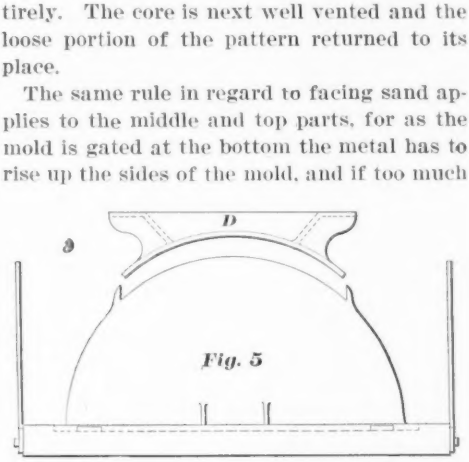


Fig. 3 *Fig. 4*

depth of the flange below the joint of the drag. The pattern is next placed on the bed, and the edge of the flange rammed and the joints made. Fig. 5 shows the pattern with the joint made ready for the middle part; the loose portion of pattern D is placed on one side, so that the semi-circular core can be rammed up. In making this green-sand core a few irons are first driven through the drag, as in the section of Fig. 1, to stiffen the core, and the bottom and sides of the core are lined with a fairly strong facing sand. As the core is rammed up, however, the facing should be weakened until near the top of the core, when black sand is used entirely. The core is next well vented and the loose portion of the pattern returned to its place.

The same rule in regard to facing sand applies to the middle and top parts, for as the mold is gated at the bottom the metal has to rise up the sides of the mold, and if too much



coal dust is present in the facing, the result is a cold shut and ugly seams. If, however, care is taken in this respect, a clear-skinned casting which requires very little cleaning, and which puts the molder in a happy state of mind, is the result. Before putting on the middle part, the pattern is well rapped so that it will leave the core easily. The middle part is now rammed up. Very little venting is required, as holes cast in the sides of the box serve to take the air off. After making the joint, the top is rammed and lifted on to trestles, the top portions of the patterns are withdrawn, and these parts of the mold finished. The middle is now hoisted off, care being taken to keep it as level as possible until out of the guides. The pattern which has come up with the middle, should now be rapped easily out of the mold.

In finishing the mold, a little molasses water, used near and round about the gates, and dried for a short time, will prevent any tendency to scab.

The mold should be poured at a fairly quick rate, and with hot metal.—G. Buchanan, in Mechanical World.

Scabs and Buckles—Their Cause and Effect.

BY EDWARD E. GILMOUR.

Scabs and buckles upon castings have been the cause of a great many very unpleasant discussions in the foundry not only between the molders themselves, but with the foremen and the men. They have also been the cause of separating good molders from their foremen simply on account of an incorrect knowledge of their cause. In the first place, it is essential that we should arrive at a definite conclusion as to what is a scab and what is a buckle. This is necessary, because when an inquiry is made as to the cause of an unsightly casting you must know whether it is a scab or a buckle, as the cause of each of these effects is of an entirely different origin and in answering an inquiry you have to take this important fact into consideration.

A scab is an unsightly raised part on the casting indicating that some part of the mold has been washed away with the metal from one of the following reasons: the dropping of the gates, the sand being too wet, too strong, too weak, or too close in the grain to give a good exit for the gases generated while casting. The cause of a scab can, as a rule, be easily determined, as any intelligent molder can very readily discern this when he examines the material and the circumstances attending its production.

A buckle is an indentation in the casting which runs in peculiar shapes, showing that the finished part of the mold has been pressed right into the thickness of the metal. In the case of buckles there have been different theories brought into debate which look very rasonable and have been adopted as the cause of the defect, but with the repeated recurrence of the same trouble, these have been shown to be wrong. For instance in shops where they make large marine and stationary cylinders, it is very rare that they ever turn out a cylinder which has not got a buckle on the center or main core and in every case the cause is attributed to binding the core too hard. This is the opinion of a great many men and you cannot change it.

They build all cores with loose joints (that is, open joints) between the bricks with the idea that the gas which is generated in the material will have a free exit while the mold is being cast. This is where the trouble begins and the results are fatal, as they have violated a natural law and the inevitable consequences must follow. There is no exception to this law, even in the foundry there is no such thing as "luck," as many molders will say when they are in trouble. The plain fact of the matter is, that through ignorance, neglect, or carelessness, they have violated the laws which govern such matters and the natural consequences follow, as every effect has an adequate cause. In a great many of our leading foundries in this country the same idea is very prevalent. In building a loam mold it is very essential to fill every joint perfectly solid, because if there are any spaces left in the joints of the bricks, in the process of casting these accumulate gas, which must be released as it generates and the consequence is that it will pass out by the easiest channel, which in a great many instances is through the face of the mold and if it should go that way it will cause a buckle, because the pressure of the gas will burst the loam from the face of the bricks.

As the iron enters the mold it burns the gas out of the space for the metal or thickness, as it is termed, in the mold and causes a vacuum and there being no pressure inside the mold the loam is very easily forced out. Buckles in the mold are usually formed before the iron reaches that part, as it will readily be seen that the escaping gas has burst its way into the mold and when the iron reaches that place it goes round the back of the loam and almost encases it completely, consequently it is advisable to pour the castings as quickly as possible, keeping the riser gates closed and maintaining the pressure of the air on the face of the mold until the metal reaches the top. Buckles, as a rule, are only on loam and dry sand molds. They may also be caused by a mold not being dry enough, as the steam which is generated by the heat of the iron will mix with the gas and force its way through to the inside.

In casting flat plates it is advisable to cast them with the mold in an inclined position, as this saves the air from burning out and leaves a vacuum which keeps the mold

from buckling or drawing down. In making large condenser doors which are from 1½ to 2 inches in thickness, it takes some time to pour such pieces and in order to get good solid castings and free from buckles you must pour them on an angle of about 25 or 30 degrees and pour from the lower end.

In heavy dry sand molds it is good practice to cut a ridge about an inch wide and of the same depth around the mold four or five inches from the pattern and every four inches in that ridge put large vents clear to the bottom of the mold. These serve to conduct the steam away from the face of the mold while drying and if the mold is dried as far as the vents it is all that is necessary. Before setting the cores it is advisable to fill these vents with fine cinders, making a connection through the ridge into pipes at different places to carry off the gases generated while pouring. If this system is strictly followed out there will never be trouble with buckles on dry sand castings.

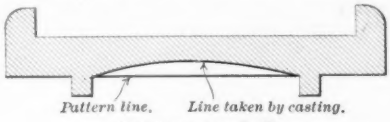
In loam castings there are often dark lines which run all over the casting and upon close observation it will be seen that these are hollow and run in every conceivable shape, closely resembling a map. The name given to these lines by the molder is veins, and these are simply miniature buckles caused by cracks in the mold and the gases finding an easier exit into the mold than out of it; the pressure of the gases being greater than the pressure of the iron cause this indentation.

These veins are not injurious to a casting but they give it a very bad appearance and should be avoided at all times. They occur more often in loam molds that are blackened dry and some molders have the practice of ripping out the cracks wider so that they can get them filled up more perfectly. This is a mistaken idea as the fresh loam put into the large cracks shrinks and leaves a fine vein which does all the damage. I have made a number of experiments on this matter and found in every case that it was better practice not to rip the cracks but in dressing simply wet the mold good and use the dressing loam soft, which will run into the cracks deeper and prevent the gases from blowing through the face of the mold and also saving time.

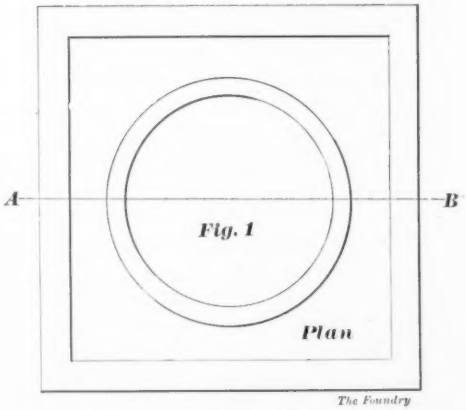
A man without ability to originate never makes a good manager

What Caused It?

A number of jobbing molders send us the sketches appearing in Figs. 1 and 2 and ask for a theory as to the cause of the concave



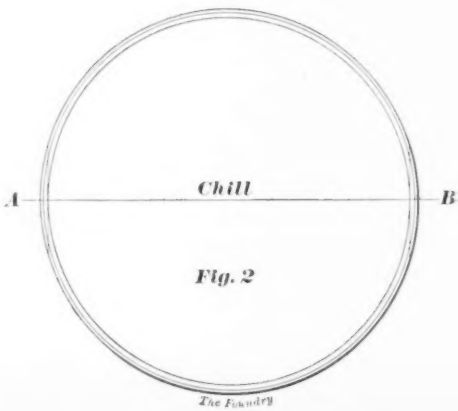
Section on A-B



portion of the casting as shown by section Fig. 1.

That the reason for this phenomenon does not lay within ordinary lines is evidenced by the fact that twenty castings were made without showing a blemish in any way.

Section A-B

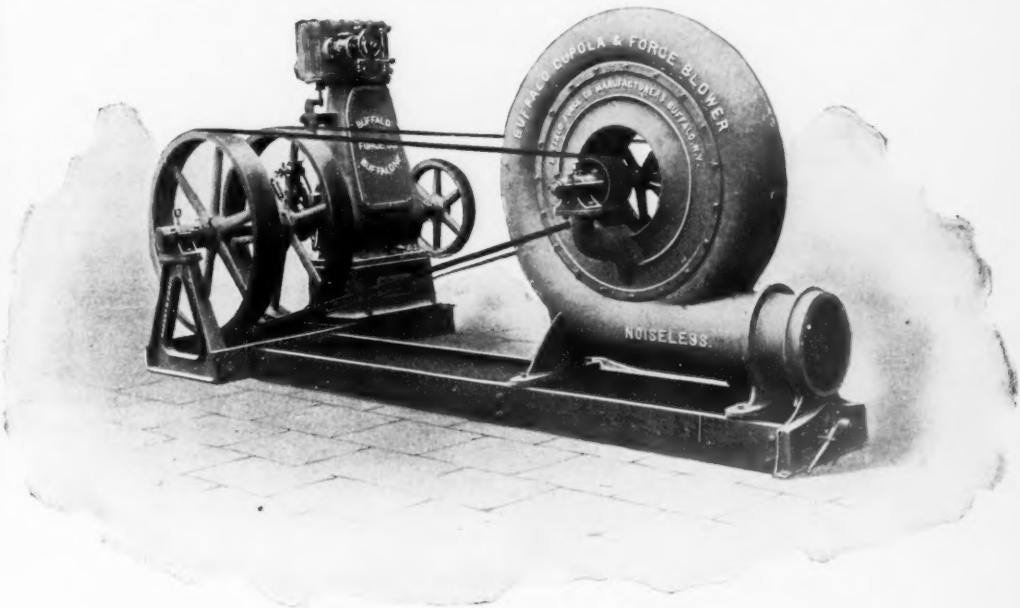


The hollow portion of the casting was as smooth and perfect as if it had been intended to make it of this shape. No signs of blowholes or other commotion in the metal being visible.

Undoubtedly the fact that this part of the casting was formed by a chill is at the bottom of the peculiarity, but why?

A Special Cupola Blast Apparatus.

For the purpose of producing the blast necessary for foundry cupolas, the centrifugal blower or peripheral discharge fan, by reason of its simplicity and adaptability, has come to be recognized as a most efficient device for the desired end. In this connection it may be well to recall the fact that the disc wheel type of fan discharging air in lines parallel to its axis is unable to develop the pressures customary in cupola practice, while the reciprocating piston type or blowing engine, in addition to comparative complication, finds its sphere of greatest usefulness and efficiency in high pressure service. The centrifugal fan, then, with its single moving part and its simple rotary motion, presents itself as the most satisfactory solution of problem of providing cupola blast.



BUFFALO STEEL PRESSURE BLOWER.

In order that combustion in the cupola may proceed with satisfactory rapidity, it is essential that the proper amount of air be supplied to the fuel. To effect this a certain pressure is necessary, and what this pressure must be depends in any given case upon a number of considerations. Of these the most important are the rate of melting demanded, the manner in which the cupola is charged, and to some extent the size and number of the cupolas. The blower must also develop sufficient pressure in excess to overcome the frictional resistances of the blast piping. It is now well established that the best results, i. e., the most satisfactory melts, are attained by employing the lowest pressure which will deliver a sufficient volume of air to the fuel. In other words, the constant tendency of foundry practice has been toward the reduction of the pressures employed and the increase of the tuyere area, with the attendant result of a decreased power consumption.

The pressure which a fan develops varies approximately as the square of the speed, and the power required varies as the cube thereof. The velocity with which the air issues from the fan is very nearly equal to the peripheral velocity of the blast wheel. In order to secure the peripheral velocity necessary for a given pressure we might use a small wheel with a high speed, or a wheel of large diameter running at a low speed. Such efficiency considerations, however, as the

proper proportions of the inlet and outlet openings, and of the wheel and blades, enter to determine the dimensions of the fan for a given capacity and pressure. As the power consumed varies as the cube of the number of revolutions, it may easily be seen that great loss is entailed by using too small a blower, and speeding it up to secure the desired pressure. These small centrifugal fans or blowers may be classified as volume blowers and steel pressure blowers. The former are designed with wide wheels and in general for very low pressures. The steel pressure blowers common in cupola practice are constructed with narrower wheels, and being intended for somewhat higher pressures, are driven at higher speeds. In consequence of this latter fact, greater care in design and construction is necessarily to be exercised.

The accompanying illustration shows a complete apparatus made by the Buffalo Forge Co., of Buffalo, N. Y., and designed to meet the trying conditions incident to foundry blast service. The main fan casing and the discharge orifice is a single-piece steel casting, and to this is securely bolted the two side plates carrying the bearing brackets. Ring-oiling bearings support the wheel shaft, on which are the two blower pulley wheels. The blower rests on one end of an adjustable bed; at the other end is placed a countershaft with two driving pulleys direct connected to the shaft of a Buffalo double upright automatic engine. This engine is enclosed to run in oil, and the strictest attention has been paid throughout the entire construction to ensure that efficiency of lubrication so essential to smooth running at continuous high speeds. In the case of the engine shown in the cut, steam admission to the two cylinders is controlled by a single valve, which itself is actuated by a governor on the rear pulley wheel. As will be observed, these two driving pulleys are belted to the blower pulleys. A simple device on the bed makes possible a longitudinal movement of the whole blower for the purpose of tightening the belts while the apparatus is in operation. In order that this may be accomplished without disturbing the blast piping, a telescopic mouth piece is fitted to the blower outlet.

The advantageous features of such a blowing plant are many in number. In the first place, the design and construction is such as to secure high speeds without harmful vibration. Lengthy service with minimum attention is the result. Again, the apparatus is complete in itself, and can be operated when desired, and then at speeds variable for best results under varying conditions. In addition, the fact that the engine is wholly enclosed renders it most fitting for service in the dust and grit laden atmosphere of the foundry.

A. W. [illegible].

A Couple of Questions.

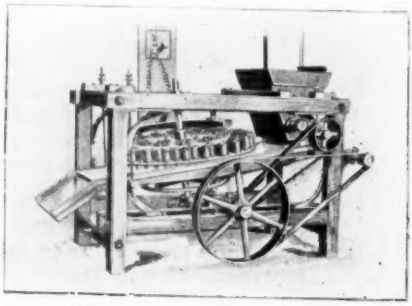
What readily applied coating can be put on castings to keep them from rusting? It should be easy of application, preferably by dipping, and should dry quickly.

Is it possible to cast solid balls of brass, weighing from fourteen to fifteen pounds, in an iron mold? They would have to be clean and solid enough to turn up bright.

ROBT. BUCHANAN.

Magnetic Separators.

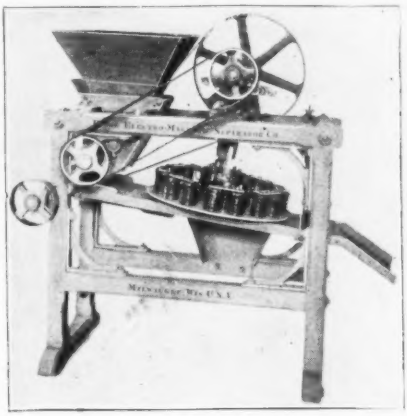
The idea of using magnets for separating iron from non-magnetic materials is an old one, but up to quite recently no magnetic separators have been designed that combined the points of capacity, practicability and perfect work. There are, however, now on the market several magnetic separators of more or less merit, and many modern foundries and machine shops are being equipped with them. Among the latest designed separators are those built by the Dings Electro-Magnetic Separator Co., of Milwaukee, Wis., two sizes of which are herewith illustrated.



DINGS NO. 2 SEPARATOR.

These machines are a departure from the ordinary cylinder type of separators, the makers claiming that it is impossible to magnetize the whole surface of a cylinder by putting magnets or coils inside of it. The poles of a magnet only attract, and when

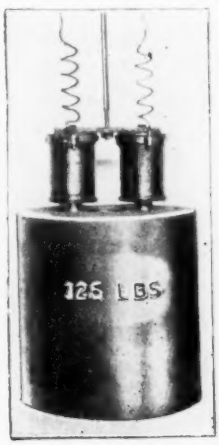
their poles can only be arragned to present spots of attraction on the surface of the cylinder. If the poles are close together they neutralize each other's lines of magnetic force; hence, these spots of attraction, to be strong, must be some distance apart, and chips of iron in the stock being fed over such a cylinder must fall upon these spots, or very close to them, else they escape. Again, the magnets must not only overcome the gravity of the iron but the momentum



DINGS NO. 1 SEPARATOR.

of the fall, and the weight and blows of the heavy non-magnetic stock behind it, else the iron is carried along with the stock and the separation is not perfect.

The Dings brass separator is what is known as the disk type of separator. It is provided with a rotary disk carrying pow-



MAGNET FOR DINGS SEPARATOR.

erful electro-magnets over a stock conveyor, the conveyor motion and the speed of the disk being so adjusted that the sweep of the magnets bring every part of the stock twice within a strong magnetic field.

The magnets are very powerful, as is shown by the illustration herewith, taken from a photograph of one of the magnets sustaining a piece of large steel shaft. The magnet weighs 3 lbs. 6 ozs., and used 12 Watts of current in this test. There are 24 of these magnets on the No. 2 separator, each one being able to sustain 35 times its own weight. The cores and yokes of the magnets are of the softest Swedish iron, and drop their loads instantly when cut out. The Dings people have secured some valuable patents covering magnetic separators, and have others pending. They build electro-magnetic separators exclusively, and have made elaborate experiments with machines for handling brass stock and cupola slag.

Pattern Work that Helps the Molder.

In pattern work there are many small and seemingly insignificant items which, if the pattern-maker would only realize and attend to them, would be greatly appreciated after the pattern reaches the molder's hands. The sticking of dowel pins is a source of annoyance to a foundryman, and one from which he really ought to be free, for it reflects directly back to the pattern-room, and, although a little thing, it is one about which a few words may not be amiss.

The requirements of dowels on a pattern are to keep each half in its exact position, so that the outlines will perfectly coincide, and, by the way, this is just as essential on the flask, and if either the halves of the pattern or the parts of the flask are loose or "chuck," as we say, then the casting is sure to tell the tale, and show a bad line where one half overlaps the other. It is not the length of a dowel pin that counts, but it is the fit, and there is nothing like metal pins for constant use, for when they are nicely mated they will never be affected by the dampness with which they come in contact in the foundry as do wooden ones. There are many kinds of metallic dowel pins used, but I prefer those which can be inserted by simply boring one size of hole in each half of pattern. In these the half having the pin or peg is shouldered down from the main diameter of the stock to a size fitting the hole or socket in the other half, magnets are placed inside of a cylinder

so but one size of bit is necessary for boring.

For large work circular cast plates are best, having the peg in one half and the socket in the other, and each provided with three holes countersunk for screws. These can easily be made any size in proportion to the work on which they are to be used, and can also be put in with one size of hole bored with an extension bit.

Dowel pins should commence to taper almost immediately; that is, their sides should be parallel but a very short distance up. On small ones 1-16 inch is enough for the straight part, and the taper should curve up to a point something like the sides of an acorn, although perhaps not so abruptly. The reason for having the pin commence to taper so near the base is to prevent sticking, and, as it simply is intended to hold the pattern from any movement sideways, long, straight sides would do no good whatever, but rather harm.

The worst imaginable form of pins are wooden ones, when they are put in as follows (this is a negative illustration, and *not* to be followed): Bore holes right through one half of the pattern into other half, without having them perpendicular to parting of pattern, and then drive in dowel rods so they project through the first half about three times their diameter or even more, and then whittle off the ends a little and see what happens when you try to fit the halves together.

Wood pins are bad enough at the best, for they are so apt to both shrink and swell, according to the temperature and moisture. They should always be made quite short, which will prevent their binding to a great extent. Sometimes, if they are inclined to stick, a little black lead rubbed over them will help matters somewhat.

In answer to any question covering the limit of a close fit for any kind of dowel on any ordinary pattern, I would give this simple rule: Lift the cope half, and if this can be done without disturbing the dowel half they are not too tight, but always bear in mind never to have any sideways play that can be detected.

When loose pieces are attached to a pattern by a dovetail they should drop freely into their places by their own weight. Many pattern-makers when putting a dovetail on a loose piece taper it on the two edges only, leaving the thickness parallel. This is wrong. The back as well as the edges should be tapered for this reason: When the main part of the pattern and loose piece separate the dovetail is freed from its place instantly when it commences to rise, and there is no chance for it to bind, but when it is made parallel it stands a good chance of sticking and causing trouble until it is entirely raised out of its socket.

When loose pieces are wired on, the wires should pass through freely, and on circular pieces one central wire is sufficient, for if the hole is in the exact center the position of the piece will remain constant.

In using wires for loose pieces and bosses one way to help the molder is to have them draw away in a direction calculated to cause him the least trouble when packing the sand about the pieces, and when they occur on the inner sides of a core box always put the wire through the outside of the box into the spot and not through the spot into the side of the box; by this means a wire causes the core-maker no trouble whatever, and after the core is rammed up the wires can be removed without disturbing anything. Back draft, that evil of pattern-making, need not be mentioned here, for no good workman will allow it, and the molder will be sure to curse the bad workman who does leave it on his work. A pattern can have its draft lessened on the outside until it becomes square in some instances, but that is the absolute limit, the "last straw," so to speak.

The marking of patterns is a greater help in the foundry than some pattern-makers realize, as the molder does not usually see the pattern until completed; whereas the pattern-maker is thoroughly familiar with every piece and core box, while the molder has no information except that conveyed by various marks and numbers on the pattern itself.

All things considered, I think patterns to be cast in iron should be varnished black. The lampblack in the shellac makes a body for it which acts as a filler to the pores of the wood to a certain extent, and the hard usage which patterns receive in most iron foundries will not wear the black varnish off nearly as quickly as plain orange shellac. Core prints should be yellow, to distinguish them, and the back of every loose piece

painted red; also the place on the pattern where the piece fits to be red also. This conveys a certain amount of information to the molder at the outset, and gives no excuse for any missing loose parts. The red is easily made by adding vermillion or Venetian red to common shellac. Whenever it is possible to set a core in more than one position in the mold, the core box should be fixed in some manner so that it will be impossible to place it in any except the right way. I have actually known of cores having letters on them to be placed so as to read upside down on the casting. It does seem as if this was inexcusable in a foundry, but some simple expedient which will take the pattern maker but a short time longer to do will prove an effectual barrier to such carelessness. In many other cases it would not be carelessness at all if the core would fit the mold in two or three different positions, for the molder would have no means of telling except by guessing, and hardly any two men will guess alike when it comes to an uncertain point. To prevent this trouble cut off some portion of the core print and put its counterpart in the core box to exactly match, or else add some extraneous part of any convenient size to the core print and cut out the corresponding place in the core box to precisely fit. Sometimes one way is better and sometimes the other, and they both effect the desired result.

Another point on cores is this: Try to make the core box if possible so that it can be rammed up on the plate without having to be turned over to release the core. Have the box draw away sideways when convenient, and part in such a manner that it is freed from the core instantly without any dragging. This will insure a much more perfect core with a minimum amount of rapping. This is not always possible, but can be followed out in a great number of instances if the pattern-maker would only bear the point in mind, and also the reason for it.

In the matter of pattern-making it will benefit the foundry to have every loose piece and every core box numbered the same as the pattern, and on the main part of the pattern have the number of core boxes and loose pieces and stock cores plainly painted, in either red or white. Then the molder and core-maker can collect all the parts at the outset without inquiry, and, in addition. if the diameter of stock prints are marked on them the calipering process will not have to be resorted to.—John M. Richardson, in American Machinist.

Electric Traveling Cranes.*

BY A. D. WILLIAMS.

In nearly all foundries cranes are employed to do heavy lifting, and the overhead traveler, in most cases using electric power, has become a very desirable part of foundry equipment. The idea in this paper is to consider the multimotor electric crane from the user's standpoint, taking up its desirable and undesirable features, without attempting to give a detail treatise on crane designing. The only machines that never break down are those which are never used. Cranes are no exception to this rule, and the natural depravity of inanimate objects always causes the selection of such a time as will result in the greatest possible inconvenience to all concerned. Many serious crane accidents have occurred, and some of these are no doubt fresh in the memory of Pittsburg foundry men.

The slings used in handling loads are really not part of the crane, but they are a source of trouble. Chain slings are the best; they are flexible, do not chafe, and damage to finished surfaces can easily be prevented by a little care in using. Their periodical inspection is necessary, and they should be annealed from time to time. Rope slings are liable to cut and are uncertain. In many places their use has been stopped after an accident has cost more than a good set of chain slings.

For hoisting purposes chain is most commonly used on account of its flexibility. This means smaller drums and sheaves, and a higher hoist than can be obtained on the same crane with wire rope. Only the best grade of tested chain should be used. As this becomes fatigued by long use, small cracks may develop. Its durability of course depends on the service the crane gets, and defects are not easily detected. Chains should be kept well lubricated, and annealed occasionally. Where wire rope is used its condition is readily

*Read before the Foundrymen's associations.

seen, no expert being required. In this respect it is safer than chain. Extra flexible wire rope is manufactured which is well adapted to crane service on account of the moderate size of the sheaves and drum required. It is not an experiment for hoisting purposes, but its use on electric cranes is not as common as it would be if its good qualities were thoroughly appreciated.

Hooks are made of various materials, forgings of wrought iron and steel are used in many cases, but malleable iron and steel castings are also employed. Malleable castings are only used for very light sections. For heavy work forged hooks are universally employed, and cast steel hooks have been used for medium size cranes. A first-class steel casting is much better than a poor forging, though the material to be specified is largely a matter of individual preferences. With proportions suited to the metal, it makes very little difference what is used, the chances of flaws are about even, and a burnt forging is not any more reliable than a defective casting.

Some cranes are so constructed that in hoisting and lowering the load is twisted more or less around a vertical axis; this necessitates extra care in its guidance. This style of hoist is not well suited for foundry purposes, as the attempt to correct this twisting can be very easily overdone with disastrous results. For the foundry a vertical hoist without any twist in it fits the bill best, and for almost all purposes is the most desirable.

The electric motors, controllers and wiring on cranes should all be arranged and constructed so that repairs can be easily and quickly made. Perfect insulation is impossible, as all substances conduct electricity more or less. There are a number of grades of insulated wire, and a good quality run on porcelain insulators or in molding arranged so that no two wires can come in contact with each other or with any metal should be insisted upon. Nearly all the electrical troubles with cranes arise from imperfect insulation. No detail is too small to be slighted in this respect, as fine dust and "flyings" are liable to settle anywhere, and a ground or short circuit from this cause may be expensive. Wooden battens should be used to prevent the trolley from swinging against the girders, but wood alone should never be depended upon as an insulator.

Crane controllers are important, as the entire manipulation of the machine depends upon them; this, like the clutch of the mechanically operated crane, is a weak point. The practically perfect crane controller is yet a matter of the future. All parts should be accessible, and so arranged that those subject to wear can be removed and replaced with a minimum amount of trouble. The resistance coils could be arranged so that close control over the crane can be obtained, as without it delicate handling is impossible. The device by which the operating levers are centered, or held in the position, at which the current is off, should be so positive that the operator is not likely to throw the lever too far and reverse unintentionally. Any weakness in this device is a constant source of danger, yet it is desirable to have easy working controllers.

The electric motors used should be enclosed in dust-proof casings; those built for crane service by the large electrical concerns are very compact and accessible, their designers have had the benefit of wide experience gained in street railway work, and the motors they produce give very little trouble. Standardization of all parts has been followed out, so that repairs are in most cases very simple, and extra parts can be carried in stock. Special motors are things to be avoided; a bill for repairs would furnish sufficient explanation. The armature and commutator of a motor are its two most vulnerable parts, and it is much easier to remove them when attention is required than to attempt their repair in place. In most cases removal is absolutely necessary. A set of spare armatures add to the cost of a crane, but it will save a delay at an inopportune time, as slight faults can be corrected which, if given time to develop, would prove expensive.

Crane brakes or safety devices are of two kinds; one which acts upon the interruption of the electric circuit for any cause, the other operated by the load. The former is generally called the magnetic brake, because it is thrown out of action by magnetism, being thrown on by a spring or by gravity. The force of gravity is not very likely to fail; springs are not so reliable.

The braking effect is obtained by a cast iron drum keyed to one of the shafts (preferably the armature shaft) where its effect will be greatest, and a brake strap acting on the drum. This strap is often made of sheet steel and its friction surface fitted with a renewable lining of wood, leather, or other suitable material. Naturally this brake strap requires adjustment from time to time to take up the wear. This brake is made single or double acting, its principal duty is to overcome the inertia of the armature and to stop the load promptly. It should, however, be of sufficient size to hold the load. The designing of one of these brakes presents some interesting problems. Too little of it is only an aggravation, and when too large it is troublesome and may twist a shaft in two by stopping one end before the other. A modification of the Weston disk brake has also been successfully used as a magnetic brake.

The load brake, variously called the automatic brake, safety retaining clutch, mechanical brake, etc., is made in a number of designs by different makers; the basic principle is the same in all. The tendency of the load to run down acts to set the brake, which is arranged to permit hoisting freely. In lowering the motor acts against the tendency of the load to lock the brake, and the load cannot move until these two forces balance each other; the brake absorbs the acceleration of gravity on the load so that it can only drop at a speed proportional to that of the motor. It might be said that the motor has to push the load down; this does not describe the action accurately, but it is close to it. It is highly important that the operation of this device should be smooth; any irregularities in its action cause the load to descend in a jerky fashion, which means excessive strains in the whole structure, and tends to develop defects. While no apparently serious results may appear at the time, there is the ever-present risk that some part may have been overtaxed and cause a seemingly inexplicable breakdown in the future.

The mechanical elements of a crane are very simple—a few gears, track wheels, shafts, the motors, drum, brakes and the necessary framing to support and hold the mechanism, is about all there is to the trolley, but it will not do to put this together in "any old way." The phrase, "in a workmanlike manner" is susceptible of various interpretations, as there is no particular standard, and each one must judge according to his own lights. It is hardly necessary to say that cost counts in cranes as in everything else. The crane builders are not in it for pleasure and the shop facilities as well as the number that can be built from one set of patterns is important; all changes add to their costs, and the endeavor is to get up a set of standard sizes that will enable them to suit the general run of customers with most of whom the price decides the question. The maximum amount of trolley travel calls for a short trolley. The minimum of headroom can only be secured by a low trolley. The maximum amount of hoist can only be obtained by a trolley which can be placed close to the roof chords. Ease of repair requires that all parts shall be arranged so that any piece can be removed and replaced with a minimum amount of trouble and labor. All bearings should be capped, as shafting has a habit of getting bent so that it is impossible to remove it from a solid bearing without cutting it to pieces. With hack saws this is a tedious job, but it can be done very rapidly by burning the shaft in two by an electric arc, provided power enough is available. With capped bearings bent shafts can be removed and straightened, perhaps they ought not to become bent, but it does happen just the same. With cranes it is not easy to make repairs; the space to move around in is limited, and the risk of a tumble makes a man cautious, and often one hand only is available. This fact is not as thoroughly appreciated as it should be by crane designers.

Crane gears are important items, particularly as they wear out in time. Cast iron gears, if properly proportioned, work well, but it is a good plan to have pinions of steel. In this combination the pinion wears out before the gear. In a great many cases a little more pig iron would improve the gears. Where this is the case cast steel can be used to advantage in making repairs, as owing to the limitations of space, etc., it is rarely possible to make any changes in the main dimension.

Lightness is particularly important in a crane as it counts in the girders requisite,

but a crane that is too light is continually giving trouble, and in the long run it costs more than a heavier machine.

Safety devices of different kinds are occasionally employed to prevent over-hoisting, and running the trolley or bridge full tilt into the end stops as commonly designed. Their utility is questionable, for the crane operator can hold the circuit breaker in and at the same time use the controller to get back past the safety line. The best arrangement of such devices is to place them so that the operator will have to call assistance to hold the circuit breaker in until he can run back to a point where it will stay closed. When the operator finds that he gets caught in this way it is only a matter of time before he discovers a way to get around the circuit breaker. Over hoisting generally brings a pretty good strain on the mechanism. It is very likely to result in broken chain sheaves and a bending of shaft. One accident of this kind is about all a crane operator should have charged up to him, and unless he loses his head the results are not very serious. Running the trolley or bridge into the end stops at full speed is a very efficient way of testing the strength of the crane girders and runway, but there is a certain amount of danger in it, so that it is not advisable to do this intentionally. It is an expensive job if anything fails, and more than one crane has refused to stop at the end of the runway. This accident has also been caused by high winds, showing that for a yard crane a good anchor is necessary. The longitudinal and lateral strength of a great many crane runways is much lower than it should be, as only the static loading is considered and the roof trusses are depended upon for sway bracing. As they are not designed for this, the whole building is easily swayed in both directions by the crane.

The track wheels are depended upon, in most cases, for keeping a crane in line, or square, on the runway. These wheels should be of the same circumference. Double-flanged wheels of cast steel or cast iron with chilled treads are used, both materials give satisfactory service. Chilled tread wheels should have their flanges made in sand, as otherwise there is considerable liability of the flanges breaking off in case the crane gets badly out of line or the runway varies from gauge. With steel wheels the liability of breakage is diminished, but being soft the tread is likely to wear. The flanges are sometimes rolled over and spread apart by a poor runway; this on driving wheels having a gear mounted on their hub forces the gear over so that it cuts into the truck beam. The removal of a steel wheel when this has occurred is a very pleasant piece of work.

It is almost impossible to keep a crane absolutely in line or square, but if proper precautions are taken it is possible to get very fair results. The line shaft should be driven as nearly midway between its ends as practicable, and is preferably a little too large than too small. It may be well to say that what is large to one man may seem small to another. When the line shaft is driven near one end there is a certain amount of torsional spring to it that permits one end of the crane to lag behind, producing a racking action that does not improve the wearing qualities of the machine. This same effect can also be produced by starting the bridge travel suddenly with a heavy load close to one end. It is perfectly practicable to connect the girders and track beams so that this injurious racking tendency can be, to a large extent, overcome, but it is not often done.

Runways that are out of line or not level, or a combination of these two defects, do not have a good effect on a crane and cause excessive wear on the bridge driving mechanism. The correction of runway imperfections is comparatively simple, but unless the structure is very thoroughly braced, it will soon be as bad as before.

There are a number of types of crane girders, two connected at the ends being used for all except very light machines.

The single webbed plate girder was extensively employed at one time. The bottom chord, however, has a tendency to vibrate considerably when the crane is in motion. This is increased by sudden starts and stops. The weight of the line shaft and motor causes torsional strains and the metal is not well distributed to resist them. Rapid starting and stopping increase these strains. This type of girder is not used for high speed cranes unless sway bracing can be used; in

this case the trolley is placed between the girders and runs on the bottom chord. Where the trolley runs on the top chord a system of auxiliary latticing can be used, making in effect two girders at right angles to each other and by this means a high degree of lateral stiffness can be obtained at the sacrifice of simplicity.

The double webbed plate or box girder is the simplest form used in crane work, the metal is well distributed to resist all the strains met in service, the rivets can all be driven by machine, the use of stiffeners for the web plates can be avoided by using distance pieces and bolts or long rivets to hold the webs. These girders can be made as stiff as desired laterally and vertically. Occasionally a girder of this kind is made very deep and light web plates used, but this sacrifices almost all the stiffness and is not very good practice. The principal disadvantage of the box girder is that there is no way to inspect or paint the inside.

Lattice girders are used extensively for yard cranes on account of the small amount of exposed surface. They are also employed for long span indoor cranes. The trolley can be placed on either the top or bottom chord to suit the conditions met with.

The failure of crane girders is comparatively rare, as they can generally hold a considerable overload, nevertheless it is not a good plan to use a crane for anything heavier than its rated load, as this has a tendency to develop weak spots that in the future may cause trouble. In some cases a five-ton crane has handled nearly twenty tons, but the operator was taking big chances of spoiling the machine and starting several funerals.

The effect of impact on cranes is often neglected. In rapid working these stresses may be equal to those due to the dead load, so that the factor of safety is only one-half of what it would be if these stresses were taken into account in the first place.

Some of the foregoing remarks apply to cranes that are not driven by electric motors, and it is hoped that some information useful to crane users and the prospective purchasers of the machines has been brought out.

In the foundry, as well as in some other places, it will be found that the electric overhead traveler furnishes no panacea for difficulties inherent to the handling of heavy work, though it is a valuable accessory. A large part of its calls are for turning molds, lifting copes, etc., which are too heavy for the molder. Very often it is necessary to hold such a load for some time, while there may be other floors waiting and losing valuable time. The old foundry jib crane should not be discarded on the advent of the traveler, but rather should be reinforced by a number of light jib or post cranes, so that the traveler can be used at its maximum efficiency on lifts proportionate to its capacity.

A great many crane breakdowns are due to carelessness or forgetfulness on the part of the crane operator. For instance, he blocks the gearing with a bolt or nut while making some slight repair, then starts the machine and the firm sends out a rush order for new gears. It is a good plan to carry a set of spares for all parts likely to become disabled or worn out in service; this avoids expensive express charges, and the extra cost of rushed work. In ordering such spares it should be specified that each piece shall be properly marked so that it can be easily identified.

Strike Closes a Chicago Factory.

Labor troubles have led to the abandonment of the Siemens & Halske plant in Cicero, a suburb of Chicago. The General Electric Company, who for some months have operated the works, have decided to leave the place and remove the machinery and tools to their shops at Fort Wayne, Ind., and Schenectady, N. Y. The determination was arrived at six months since, when a strike occurred that occasioned a large loss to the company.

The last of the contracts on hand was finished recently, when the men were notified of the intention to abandon the site. Five hundred men are thrown out of employment.

The determination of the General Electric Company to leave the site, which was originally that of the Grant Locomotive Works, is but the last of a series of disasters that have overtaken every project started there. The Grant Land Association, who originally purchased the tract, turned it over to the Grant Locomotive Works Company, who, after expenditures on buildings to the amount of $1,300,000, failed with liabilities of $500,000. The property was sold in 1895

to the Siemens & Halske Electric Company, and they, after expending $2,000,000, quit the place. Later the tools, the Siemens & Halske patents, and machinery were sold to the General Electric Company and the buildings leased to them for two years.

It is asserted by the General Electric Company that a strike was on at the works while the sale was being negotiated, and that in order to complete the deal the Siemens & Halske Company compromised with their employes at a great sacrifice. When the General Electric Company took possession this condition of affairs was discovered, and on its being sought to be remedied another strike occurred.

"At that time," said Manager Bernard E. Sunny, of the General Electric Company, to a reporter, "the company had on hand contracts for 500 tons of castings for Milwaukee interests, besides contracts with Schenectady and Fort Wayne people. These contracts were for foundry work, which really the General Electric Company had no desire to handle, but only undertook because a large portion of the plant at Cicero consists of finely appointed foundries. As the strike occasioned the shutting down of the foundries and the loss of the contracts it was then determined that the plant was unsuitable for the business of the General Electric Company and plans were made to abandon it."

Organized Labor.

Organized labor is not a proposition, but a fact. Some facts are thawable, as is an icicle under a sun glass. Some are not, and as far as organized labor, that is here to stay. It exists for good or evil, and has a large capacity for both. It may be, and is, in some instances, unreasonable, mischief making, stupid and brutal. It can throw rocks and wreck mills, and lay violent hands on such, as in the exercise of a free man's rights choose to work while others refuse to do so. It can be dictatorial and autocratic, and put the iron hand at the throat of business. The agitator who thrives on discontent, and the politician who wants to knead the plastic dough for his own loaf, can sometimes use organized bodies of men for purely selfish ends. All this is possible, has been done, and can be done again. These, however, are simply cases of abused power, the hammer hitting the finger instead of the nail. It has been the case with all organizations where a consciousness of masterful strength tempts Goliah to challenge the shepherd boy. It is so in politics, it has been so in creed, and will continue to be so, as long as the average man has the faults as well as the virtues that are part of humanity. Still the world has rolled on for a long series of centuries and is rolling yet, and no one man power or one party power has ever yet controlled the situation. They have always vomited after meals. If any man thinks that labor organizations can have the complete mastery of the industrial situation, he is simply smoking opium, and on the other hand, if he thinks they can be wiped off the face of the earth, he is a twin-brother to the other gentleman. Labor organizations are necessary factors in the industrial world, and if wisely managed and disciplined, are sources of strength, rather than weakness. The employer of labor as a rule, recognizes this fact. He is not averse to such compacts, so long as they behave themselves and do not usurp his rights to run his own business. When they cross the line of self protection into imperialism, and are agencies of mischief under the plea of being the crusaders of justice, the man who is being kicked has the right to protest, and organized capital becomes as essential as organized labor. The danger comes into active form when mutual interests are overlooked, and out of pure cussedness or selfishness, the two parties come to blows. It is in scraps of this kind that the general and unoffending public gets a black eye. What is wanted is a mutual recognition of each other's rights, and an open-faced and manly disposition to face facts, acknowledge and remedy actual wrongs, and to shake hands without a sneaking surrender of any right whatever. It is time that this should be done, or industrial ruptures will be chronic, prosperity be sandbagged and staggered, and the usual retinue of lean and hungry men, well-fleshed demagogues and agitators, and impoverished business men, will be in miserable procession, here to-day and there to-morrow, till common sense and fair play are in the saddle.—Age of Steel.

The foundry which reduces its foreman's salary is taking the wrong road to prosperity. Better raise it, or hire some one who can earn more.

Notes on Malleable Castings.

The use of chemistry for governing mixtures is not old, but those very few firms who depended upon it regularly during the lean years now happily behind the trade for awhile, were able to spend money for improvements, while most of the others had a hard road to travel. Fortunately for the foundry foreman the "malleable" pig irons are comparatively low in silicon and therefore easy to grade by fracture; the small charcoal pig especially shows up the range from 1 to 6 in a characteristic manner. That this grading is reliable must, however, be very much disputed, for the No. 2 of one furnace is the No. 4 of another, so far as an equal silicon content would have it, and a No. 4-H which analayzed the same as a No. 6-H, from the same furnace explains why some malleable works carry so much pig iron in stock and have to shut down occasionally to remove castings and sprues to begin all over again with new irons.

If to-day any malleable works stock up and use 5's and 6's regularly in their mixtures they had better call in a metallurgist expert in this line to save them money. The blast furnaces as run to-day are far ahead in method of what they were 40 years ago. An immense amount has been learned in regard to regulating and cheapening the product, but very little in improving it. Everything to-day is for large output and where, as in making steel, any undue physical and chemical objections, sulphur effects alone excepted, can be readily corrected, and the improvements in furnace practice seem truly remarkable; but for foundry and especially malleable requirements this is not so noticeable at all. On the contrary, there are very good irons and some bad ones of the same composition, just as much in charcoal as in coke practice now as 40 years ago. The old days of cold blast charcoal iron, which iron has never been surpassed with all the improvements made, are fast going by. Whatever charcoal iron is still used in the malleable business is warm blast, and perhaps the weakest iron may correspond to the warmest blast. Coke irons have their difficulties also. A good "coke malleable" is not outranked by charcoal so far as results show it, but a bad coke iron is to be avoided at all hazards.

With a given style of furnace, the same dimensions of every part of it including the stack, any number of them when starting off new work will work practically alike. It is when the flues become choked, bottoms in bad repair and the whole furnace gets dilapidated that it must be fed with different mixtures to stave off as long as possible the time for a general repair or rebuilding. In this way a large works may have half a dozen mixtures running at the same time, but the end result should nevertheless be the same. To make a furnace last as long as possible, and yet get good castings is a part of everyday economy which can only be arrived at by knowing exactly when to do.

In spite of the species of "higher criticism" directed against silicon as a basis of foundry mixtures, the advocates of graphite would be nowhere if they tried it on "malleable." The mistake is often made that the blast furnace by furnishing an iron high in graphite or high in combined carbon will enable the founder to reproduce this in remelting. To specify any carbon or form of carbon for "malleable" is a waste of time, for the carbon point below which it is impossible to anneal is well defined and never reached even by the amount of steel it is possible to add satisfactorily to the mixtures. The form the carbon takes in the hard casting depends entirely upon the silicon contents and the casting temperature. To narrow this down still further, the carbon condition may be said, when the proper amount of silicon is present, to depend only upon the casting temperature; and here those interested may have a direct proof. Take a quickly made heat, dip out from the top of the bath enough iron to make a fairly heavy sectioned casting. Do this at the same time that the heat is tapped, and pour the first iron into a similar casting. The first will be white and the last nearly gray. The silicon of both castings will or should be identical, yet the difference in temperature between top and bottom of the bath is sufficient to make a good iron of the first and a failure of the last. Here, then, is "high" and "low" iron in the same heat, and the wise man pours the first of the top into light work and the end of the heat into the heaviest castings.

Now the above phenomenon is observed whether the phosphorus is nothing or .300 per cent; the manganese nothing or 1 per cent;

the sulphur .005 or .07 per cent. There is consequently no special need to worry about the latent heat of these ingredients provided the silicon is right and the metal is hot enough to pour into castings of the heaviest sections common to "malleable" and leave them with but very little mottling. That a variation in the impurities produces marked results in the strength of the annealed casting is but natural, but so far as obtaining ordinary work is concerned, only an excess of sulphur and possibly phosphorus need be dreaded when the carbon in the hard casting was all combined.

The annealing process does not remove any carbon from the interior of the casting at all, nor does it change the combined carbon to graphite. Hardly an appreciable amount of silicon, manganese, or sulphur is removed either in the operation, unless possibly the annealing heat is raised far above that required. The temperature of the anneal is sufficient, however, to break up the rich carbon iron compounds, or rather solutions, and the excess carbon is thrown out and as it were deposited between the rounded crystals of steel remaining. This carbon is not graphite, but of a soft and amorphous nature—probably lamp black—and any graphite which may be present in the annealed material was not likely there in the first place; the more of this the deeper the shades of rottenness resulting. Those who may be interested will find that a malleable casting, yes, even a piece of white "malleable" pig iron, may be annealed perfectly by packing it in an inert substance such as fire-clay or sand, and with a total exclusion of air.—"Low Silicon" in Iron Trade Review.

The Aluminum Bronzes.

The name aluminum-bronze includes a variety of aluminum-copper alloys in which the copper predominates which, according to their respective proportions in weight, have very different properties. The name aluminum bronze does not denote, as is often believed, a certain alloy, but includes a large number which vary in their properties from the greatest ductility to the greatest hardness. In using aluminum bronze it is therefore important to select the right alloy for the desired purpose.

Specific gravity: From 8.37 to 7.65 at an aluminum percentage of 3 to 10 per cent; melting point 1100 deg. C. for an aluminum bronze with 10 per cent of aluminum. Color: Red gold to light yellow. Structure: In castings having a high percentage of aluminum crystalline, but after working, i. e., forged and rolled, the metal is finely grained like steel; in low percentage bronzes it is tough.

The electric conductivity is 6 to 13 per cent of that of copper for a bronze with 10 to 5 per cent of aluminum. The aluminum bronzes are apt to crystallize when cooling, and therefore if cast in sand and whenever they cool slowly, they are liable to have a large crystalline structure and but few desirable mechanical properties. The resulting great shrinkage and consequent suction easily create hollow spots and oxide layers also obstruct the flowing together of the metal and create weak spots. However, the aluminum bronzes possess very good mechanical properties when rolled or forged, but it must be remembered that on account of the reasons just given, the metal must not be treated like brass, which has been cast in sand, but like steel cast in billets or slabs. The mechanical properties are further improved by an addition of iron (about 30 per cent of the aluminum percentage) which also renders the working more easy.

The resistance which aluminum bronze offers to oxidation greatly exceeds that of all similar metallic mixtures. The influences of mineral and organic acids, sulphur, ammonia, sea water, cooking salt, etc., on aluminum bronze practically amounts to nothing compared with that of the hitherto so highly valued Delta metal and phosphor bronze. Aluminum bronze will resist equally well the solutions used in celluloid factories; also chlorine, alum, etc. It shows less wear here than the metals hitherto used. It will also offer great resistance to the action of alkaline solutions. The comparative loss in weight in treating like surfaces of iron, copper and 10 per cent aluminum bronze is 11:2:1.

It is to the advantage of the consumer to make his own aluminum bronze, i. e., to get the pure aluminum from the factory, as the cost of transporting in this way is lessened and the proportion of aluminum can be varied as desired. This is done in the following manner: First, one-half of the necessary aluminum is melted with the copper in a crucible, and when melted down, the other half of the aluminum is added. If the bronze

is to contain iron, an alloy of aluminum with 30 per cent of iron is used in place of the pure aluminum, which alloy is obtained by previously melting together cast iron with aluminum. This must be used soon after cooling, as it will crumble into powder in a few weeks. The quality of the copper is very important, and only the best grade should be used.

In melting aluminum bronze a graphite crucible is used and care must be taken to avoid overheating. The loss in melting is about 5 per cent, equally proportioned between the two metals. Linear shrinkage, 1.8 to 2 per cent. In sand casting, whenever possible, the casting, on account of the shrinkage, should only be cooled on three sides, the fourth remaining open. Large masses must always, if possible, have gates of the same diameter as the piece itself. If the gate is kept full when the flow is sufficiently rapid, the oxide layers will rise to this, and also in consequence of the stemming of the flow through the narrowing of the diameter of the gate below the pouring basin only the pure metal will reach the casting itself. In small castings, where this method would require too much metal, a riser becomes necessary; a sufficient restriction of the scum is accomplished when the inlet is reduced immediately where it connects with the casting, its width being regulated by the size of the casting. The smaller the inlets to the casting, the cleaner it will be.

In rolling, forging and pressing, as has already been mentioned, castings made in slabs must be used here, in the making of which the following must be observed: To insure the unrestricted rising of the oxide layers the metal must flow readily. The quantity of the metal must not be too small (not under 200 pounds) so that the metal will remain liquid for some time. For the same reason the slabs must be warmed. In cooling, considerable shrinkage takes place, and therefore metal which has been kept at a high temperature in a separate crucible must be constantly added to prevent the formation of hollow spaces in the lower portion of the casting. The upper portion containing the oxide layers and hollow places must, therefore, be removed before any further work is done.

Bronzes containing iron must be cast at a higher temperature than those containing no iron. Aluminum bronze can be forged very easily. The temperature to be maintained is between a dark and light cherry red heat. The lower the temperature the more does rolling and forging increase the strength, but at the expense of the malleability. Warm forging, however, will increase the strength without decreasing the malleability. The more aluminum the bronzes contain, the softer they will be at a red heat.

Great care must be taken not to forge the bronzes too cold or with too light hammers. Only with heavy hammers and under great pressure, can the large crystals which always form in aluminum bronze in the process of casting be changed into finely grained steel-like structure. At a cherry red heat, the 10 per cent bronze is so soft that it can be forged or pressed into the finest designs. Especially when articles are manufactured in large quantities, this method should be applied, as the ease of manipulating, the cheapness, greater strength, elasticity and hardness, give an advantage over sand casting. Round articles like axles, bolts, screws, etc., should be worked out of rolled rods or wire.

As far as rolling is concerned, high percentage bronzes cannot be rolled cold at all, only at a red heat. The 5 per cent alloy may be rolled cold, but must frequently be annealed. To this, attention cannot be called too often. The oxide which is formed while heating is only too easily rolled into the sheet and will then cause streaks in polishing. Therefore, the heated sheet is cooled with sulphuric acid (two-thirds water, one-third concentrated acid) and by this means the oxide is removed. Should the oxide not disappear at once, the sheets must be placed in the solution from 12 to 24 hours. Before finishing the sheet, it is well to dip in a solution of two-thirds concentrated nitric acid and one-third sulphuric acid (but only after having used the pure, sulphuric acid solution).

Here also the foregoing applies, only in regard to soldering the following may be mentioned: Aluminum bronze containing up to 5 per cent aluminum may be soldered with tin solder, but not the higher percentage bronzes. For these, a solder consisting of twenty parts zinc and fifteen parts cadmium is used. The surfaces are first scraped clean, the sheet warmed and the solder rubbed on with an iron, the surplus removed with a brass scratch brush, and finally the surfaces are joined with the solder in the usual way. Brazing presents no difficulties. A suitable

solder is composed of fifty-two parts of copper, forty-six parts zinc, and two parts of tin or any other suitable ingredient. Brass strips can also be employed.

A clean metallic surface can be obtained and, at the same time a fine gold-like color by dipping in sulphuric acid of 30° B., washing in water, then dipping in concentrated nitric acid of 36° B., and finally placing in running water. For etching, nitric acid is also used; for polishing emery and polishing wheel.

Aluminum bronzes can be used wherever iron and steel are not suitable on account of their tendency to rust, and other alloys which do not rust have not the requisite mechanical properties. Aluminum bronzes also possess for many purposes, notably marine, the advantage of a low specific gravity.

They replace advantageously all copper, tin and copper zinc alloys:

1. For all purposes where cast iron, cast steel, or wrought iron would be difficult to work, or the common bronzes possess too little strength. Wherever it is necessary for parts of certain sizes to be better able to resist chemicals, strains, etc. It must also be remembered that through working the metal warm it becomes much more malleable than cast steel, and is not so liable to break.

2. For all purposes which have already been mentioned under "Aluminum," but where a stronger metal is desired than the pure aluminum.

3. In the machine industry respectively, for parts of machines which have to stand much wear, and, at the same time, are subject to the action of chemicals as the machines of various manufacturing establishments, paper factories, breweries, chemical and technical industries of all kinds. For marine purposes, pistols, laboratory opparatus, powder factories, etc., especially screw propellers, flasks for compressed gases, gear wheels, stuffing boxes, armatures, chains, handles and trimmings, wire rope, fire boxes for locomotives, ignition rods of gas motors, blow pipes, etc.; ventilators, spindles, anchor bolts, ship sheathing, rivets, nuts, hammers, keys, screws, perforated sheet, etc. Art castings and art work of all kinds as building ornaments, household articles, decorations, ornaments, etc.

Gold bronze which contains 3 to 5 per cent aluminum is especially suitable where a fine gold color is desired or the metal is exposed to a high temperature. It will oxidize less at a red heat than copper and iron, and is therefore most suitable for gas motor ignition rods, bolts for locomotive fire boxes. The specific gravity is 8.37 to 8.15.

Steel bronze containing 8½ per cent aluminum possesses, when forged and rolled, first-rate mechanical properties and is therefore specially recommended for different machine parts. Specific gravity, 7.7.

Acid bronze containing 10 per cent aluminum is most suitable where the metal must resist oxidation or acids. Specific gravity, 7.65.—Aluminum World.

Among the Foundries.

Love Bros. are putting up a new foundry at Aurora, Ill.

Spayd Bros. have started a small foundry at Van Wert, Ohio.

S. Lehman and H. Keller will start a foundry at Woodburn, Ind.

Hanscombe & Aldine have purchased the Wingham, Ont., foundry.

The Lakeside Iron Co., Muskegon, Mich., will build a new foundry.

The Bellwood Mfg. Co. is building an addition to its plant at Bellwood, Pa.

Costello & McArdle have begun the erection of a foundry at Brewton, Ala.

E. Chrichton & Son have started a foundry at Lethbridge, N. W. T., Canada.

Wm. McDonald and Edwin Powers have started a foundry at Midland, Mich.

The Benj. Atha & Illingworth Co. is erecting a new foundry at Newark, N. J.

The Howell Mine Drill Co., of Plymouth, Pa., is adding a foundry to its works.

W. Rounds has purchased the foundry of J. Roake & Son at Oregon City, Oregon.

Wessing Bros. is a new concern to enter the foundry business at Cincinnati, Ohio.

It is reported that the Michigan Heater Co. will build a foundry at Big Rapids, Mich.

The King-Goodman Foundry & Machine Co. has been incorporated at Cherokee, Kansas.

The Phoenix Brass Foundry Co., of Hartford, Conn., is having new works constructed.

Steinert & Co. have commenced the erection of a foundry and machine shop at Washburn, Wis.

The Pella Automatic Strawstacker Co. is adding a foundry to its plant at Pella, Iowa.

W. B. Smith has leased the foundry formerly operated by the John King Metal Co. at Garwood, N. J.

The Vulcan Iron Works, of Des Moines, Iowa, is erecting a foundry and machine shop at that place.

The Economy Brass Foundry Co. has been organized at Cincinnati, Ohio, by W. C. Murray and Edward Corker.

The Gillie Engine & Machine Co., of North Tonawanda, N. Y., are contemplating the erection of a larger foundry.

The Pierce, Butler & Pierce Mfg. Co., of Syracuse, N. Y., has lately completed an addition to its foundry 60x200 feet.

Edward E. Stanchfield, owner of the Highland Foundry at Denver, Colo., will build a new shop in the immediate future.

The Buckeye Engine Co., of Salem, Ohio, will extend its foundry and equip same with special reference to the molding of heavy castings.

The Peerless Stove & Range Co., of Columbus, O., has been incorporated by G. B. Donavin, H. E. Stafford, J. A., A. C. and J. E. Witman.

The Raymond & Campbell Mfg. Co., of Middletown, Pa., are rebuilding their foundry, destroyed some time ago, on an enlarged scale.

The Foster-Waterbury Co. are arranging to make important additions to their malleable plant. These will include a foundry 75x200 feet.

It is reported that the Colorado Fuel & Iron Co., among a number of other improvements, will erect a new foundry at Pueblo, Colo.

The Nordberg Mfg. Co., of Milwaukee, Wis., has purchased a site upon which a new plant will be erected. This will include a foundry.

The M. B. Schenck Co. has made temporary arrangements by which it will operate the plant of the Meriden Malleable Iron Co. at Meriden, Conn.

The C. L. Dorer Foundry Co. has been incorporated at Bellaire, Ohio, by J. M. Weeks, C. L. Dorer, H. Vampel, C. Simpson and W. E. Gavin.

The Reading Scale & Machine Co., Ltd., Reading, Pa., will erect a new plant, to consist of a three-story machine shop, a commodious foundry and a boiler shop, all separate.

The J. G. S. Mfg. Co. has been incorporated to conduct a foundry and machine shop at Chicago Heights, Ill., by A. W. Bulkley, C. E. Moore and J. E. Owen.

The Interstate Foundry Co., of Cleveland, Ohio, has been organized with a capital of $400,000; incorporators, Martin Mullen, P. H. Laren, George H. Ganson, Frank S. Master and N. B. Snavely.

The firm of Godfrey & Gilbert, machinists, of Ithaca, N. Y., has been dissolved. Mr. Godfrey continues the business. Mr. Gilbert, who retires owing to failing health, expects to leave next month for his old home in England.

The Taylor & Morris Co., Janesville, Wis., have been reorganized and are now known as the Rock River Machine Co. The officers are: President, R. H. Morris; vice-president, Geo. H. Marsden; secretary and treasurer, Frank B. Strickler.

The Filer & Stowell Co., Milwaukee, Wis., are endeavoring to secure additional property adjacent to their engine works for the purpose of making extensive improvements in their plant. They are particularly desirous of enlarging their foundry.

The Baker Iron Works, Los Angeles, Cal., have decided to double the capacity of their plant by adding to their machinery equipment. They propose to engage in the construction of steam engines. Their specialty is the manufacture of oil well supplies.

The Harrisburg (Pa.) Foundry & Machine Co., which last year erected a large new plant, finds that it needs still more room, and is putting up two new buildings, 30x60 and 40x50 feet. Into one of these the pattern shop will be moved, giving increased room in the main building.

The Pencoyd Iron Works, of the A. & P. Roberts Co., now a part of the American Bridge Co., are being extended at a cost of $60,000. The iron foundry will be three stories high, 100x340 feet, and the machine shop, 110x340 feet. Both structures will be built of steel and concrete.

The Charleston Boiler Works and the Elk Foundry & Machine Co., of Charleston, W. Va., will be purchased by the Vulcan Iron Works, which has been incorporated, with authorized capital of $100,000, by Frank

Woodman, Edwin Polsue, Mott Barton, George Minsker and A. W. Hager.

Robert Croft & Son, of Salt Lake City, Utah, have become a corporation under the title of the Utah Foundry & Machine Co. Robert Croft, Jr., is president; Robert Croft, Sr., vice-president; Frederick Croft, secretary and treasurer. It is reported that a larger plant will be built in the immediate future.

The Acme Machinery Works, Incorporated, have been organized at Goldsboro, N. C., with a capital of $200,000. The concern will manufacture and repair machinery and do a general foundry business. The officials are J. J. Street, president and general manager; J. A. Street, vice-president, and W. E. Street, secretary and treasurer.

Frederick H. Koretke, Robt. P. Safely, Jas. Fitzsimmons, Arthur Landry and others, of New Orleans, La., have incorporated the F. H. Koretke Brass & Manufacturing Co., Limited, to manufacture specialties in any metal and conduct general foundry and machine shop; capital stock is $20,000.

After a career of twenty years, the Dow Steam Pump Works, 108 to 120 Beale street, San Francisco, Cal., have incorporated under the name of the Geo. E. Dow Pumping Engine Co., and have removed to larger quarters on First street, from Natoma to Howard, and on Howard street, from First to Fremont, with offices at 179 First street. The new works contain upwards of 50,000 square feet of floor surface, and are being equipped with a thoroughly modern outfit of tools for the manufacture of high-grade pumping machinery in all its branches.

The Beaver Dam Malleable Iron Co., Beaver Dam, Wis., have built a fine plant of most substantial character to replace the old works destroyed by fire some months since. The new works are composed of brick and steel and are fire proof. They are equipped with three air furnaces having a melting capacity of 15,000 tons per annum. The annealing room and foundry are furnished with pneumatic cranes and motors for the economical and expeditious handling of materials and product. The company are making a specialty of railroad castings.

The Logan Mfg. Co., Phoenixville, Pa., manufacturers of steel castings, are making some extensive additions to their plant. They are extending their main foundry building half its present length, which will give them additional floor space of 50x100 feet. They will install a new cupola furnace and a new two-ton Tropenas converter. They are building a new core oven, which will double their present drying capacity, and have extended their railway siding to meet the extension to the plant, and have also added some accessories in the way of sand blast apparatus, etc. The new addition is to be equipped with pneumatic cranes and hoists.

A charter was granted recently to the Pittsburg Valve, Foundry & Construction Co., of Pittsburg. Capital, $1,150,000. The company's offices are in the Empire building. The following interests are represented by the combination: Atwood & McCaffrey, Pittsburg Valve & Construction Co., the pipe fitting department of the Wilson-Snyder Mfg. Co., the Shook-Anderson Mfg. Co. and the foundry department of Alexander Speer & Sons. The temporary organization, which is made permanent, is as follows: Henry M. Atwood, president; Joseph T. Speer, vice-president; Moses Atwood, secretary; C. A. Anderson, treasurer, and George E. Klingelhofer, general manager.

Kokomo Brass & Iron Co. have been incorporated at Kokomo, Ind., with a capital stock of $100,000, to operate a brass and iron foundry. The company have purchased the plant of the Gruschow Mfg. Co. of Kokomo, and will enlarge it considerably. The brass plant of the company will occupy a two-story brick building, 50x80 feet in size, and will have a capacity of about 2,000 car brasses a day. The iron foundry will have a capacity of about 15 tons of castings a day, and will occupy a wooden building 131x40 feet in size. The officers of the company are E. T. Hitchcock, of Chicago, president; T. J. Nerny, secretary and treasurer, and F. C. Peck, vice-president. The output of the company will be almost entirely railroad work, including car brasses and brake shoes.

Fires.

The foundry of the American Clay Working Machinery Co. at Willoughby, Ohio, burned Oct. 27.

Chas. W. Leete's foundry at Potsdam, N.

Y., together with a number of patterns, was burned Oct. 15.

The plant of the Oil Well Supply Co., located at Oil City, Pa., was burned, entailing a loss of $50,000.

In a big fire at Oshkosh, Wis., the Geo. Challoner's Sons Co. suffered a loss of several thousand dollars.

The Franklin Foundry Co., of 1155 Paulina street, Chicago, had its foundry burned to the ground recently.

The John B. Morris Foundry Co., of Cincinnati, Ohio, had its plant damaged to the extent of $5,000, Nov. 2.

The Louisville (Ky.) Foundry & Machine Co. had their plant totally destroyed by fire. Loss estimated at $20,000.

The Erie City (Pa.) Iron Works, manufacturers of stationary engines, sustained a fire loss of $80,000. Two hundred men will be temporarily thrown out of employment.

The foundry operated by the McIntosh-Seymour Co. at Auburn, N. Y., was destroyed by fire. Loss $20,000. The plant was being operated night and day. The loss is fully covered by insurance.

Personal.

P. H. Dunn, of Canastota, N. Y., has taken charge of the foundry department of the McElwaine-Richards Co. at Noblesville, Ind.

W. A. Kenney, hitherto foundry foreman for B. B. Noyes & Co. at Greenfield, Mass., will hereafter have charge of the A. S. Cameron Steam Pump Co.'s foundry, New York City. He is succeeded at the Noyes' shop by John E. McLaughlin.

Fred W. Smith, manager of the Standard plant of the American Radiator Co. at Buffalo, N. Y., has tendered his resignation, to take effect Feb. 1st next. Mr. Smith was formerly secretary and manager of the Standard Radiator Mfg. Co. When that company was purchased by the American Radiator Company he became manager.

Notes from Various Sources.

The American Bridge Co. will erect a foundry and other shops for the North German Lloyd Steamship Co. at Bremen, Germany.

The J. S. McCormick Co. of Pittsburg, Pa., say that the fire at their plant Nov. 10 will in no way interfere with their business or the prompt shipment of orders.

The J. D. Smith Foundry Supply Co., of Cincinnati, Ohio, say that the recent fire at their plant will in no way interfere with their promptly filling all orders.

The Tabor Mfg. Co., the well-known builders of molding machines, announce their removal from Elizabeth, N. J., to their new shop, south-east corner Eighteenth and Hamilton streets, Philadelphia, Pa.

The Virginia Iron, Coal & Coke Co. announces that Crocker Bros., of New York, and N. S. Bartlett & Co., of Boston, have been appointed joint agents for the product of that company in the territory east of the Alleghenies and north of Richmond, Va. The Dominion of Canada is also included.

The American Machine & Foundry Co., of Hanover, Pa., has opened a night school for the benefit of its employes. There are four sessions a week, two for boys and two for men. Instructions are given in higher and lower mathematics and mechanical drawing. We are advised that the foundry employes have taken kindly to the movement, and are availing themselves of the chance to become informed upon subjects with which the average molder is entirely unacquainted.

The Willson Aluminum Co., of New York, manufacture two grades of ferro-chrome, one of which is crystalline and the other solid. The crystalline can be broken into very small pieces, and is preferred by parties who use it in small quantities and small heats. The sundry analyses of crystalline ferro-chrome are as follows:

Cr.	.67.	to	68.	per cent
Si.	.49	to	1.25	"
P.	.005	to	.007	"
Sul.	.007	to	.199	"
Fe.	24.383	to	20.000	"
C.	8.05	to	10.5	"

Analyses of solid ferro-chrome.

Cr.	70.54	to	70.21	per cent
Si.	.75	to	.66	"
P.	.007	to	0.016	"
Sul.	0.053	to	0.042	"
Fe.	22.57	to	22.04	"
C.	6.03	to	6.87	"

The Attalla Foundry & Machine Co., of Attalla, Ala., have for some time past been using molding sand from a deposit covering several hundred acres located on the Alabama Great Southern Railway a short distance from Attalla. The sand is the top soil and ranges from four to ten inches in depth. It has been in cultivation for several years

and shows up favorably with the surrounding land agriculturally. Directly beneath the molding sand is a four-foot strata of brick clay, which tests have proven to be of a very high grade.

Deaths.

George S. Gordon, an old-time foundryman, died recently at Peekskill, N. Y.

John A. Trefts, of Farrar & Trefts, boiler and engine builders, of Buffalo, died at his home in that place Oct. 12, from paralysis, after an illness of more than two years. Mr. Trefts was born in Wurtemburg, Germany, in 1823, and came to this country at the age of eight, was soon left an orphan, dependent entirely upon his own resources. He became apprenticed to an iron firm in Pittsburg and learned the trade of iron molder, and up to within a few years of his death was recognized among iron men as one of the most expert foundrymen. In early years of his life Mr. Trefts became superintendent for one of the large iron foundries of Pittsburg, and then in the early sixties, when the excitement broke out on Oil Creek, he was among the first to invest. With the late William Parker, John Cornwall and other well known pioneer oil producers, Mr. Trefts became extensively engaged in the producing business. It was he who invented the first set of drilling jars used in drilling oil wells, and thereafter made many improvements in methods of drilling. Leaving the oil country, he became identified, in the capacity of superintendent, with the well known engine and boiler manufacturers, George W. Tifft & Sons, of Buffalo, N. Y. In the late sixties Mr. Trefts went into partnership with his brother-in-law, Mr. C. M. Farrar, and established the works in Buffalo.

George W. Hamilton died at his home in Brooklyn, N. Y., Oct. 22. He was born in Granston, Scotland, in the year 1816; came to this country when a boy, and settled in Middletown, N. Y. He first entered business in New York City in 1832, and made his home in Williamsburgh in 1849. He formed the Ritchey & Hamilton Foundry Company, at Hope street and Marcy avenue, and remained in that business until he retired in 1857. He then went to Minnesota, but because of the unfavorable climate, returned to Williamsburgh in 1862. He was with the J. L. Motts' Foundry on Walton street until the firm moved its foundry to Mott Haven, N. Y., in 1898, when he retired.

Jeremiah J. Dwyer, superintendent and assistant manager of the Peninsular Stove Company, Detroit, Mich., and son of James Dwyer, president of the same corporation, died at his home in that city on October 11, aged 33.

Daniel L. Cobb, of Chicago, sales agent for the Sloss-Sheffield Steel & Iron Company, died in that city Oct. 13 after a short illness. Mr. Cobb was 45 years of age and was born at Lusby, Ky. His entire business life was spent in connection with the iron trade. He was employed as a young man by the Peekskill Iron Company, Peekskill, N. Y., and was with them for two years learning the manufacture of iron; thence he went to New York City, and served as an apprentice in a foundry for three years, thoroughly mastering the trade of molder. He then became a partner in the firm of Hugh W. Adams & Co., New York, pig iron and commission merchants, representing northern and southern furnaces, embracing among the latter at different times the Tennessee Coal, Iron & Railroad Company and the Sloss Iron & Steel Company. In 1894 he removed to Chicago to become the direct representative of the Sloss Company, and held that connection until his death.

John Simmons, president of the John Simmons Company, 110 Centre street, New York, died suddenly at his residence in Brooklyn, N. Y., recently. Mr. Simmons was born in Wexford county, in the north of Ireland, in 1834, and came to this country with his parents when a child. He received his early education in the public schools of New York, and began his business career with the firm of Hunter, Keller & Co., manufacturers of steam heating supplies, with whom he remained for 25 years. On the dissolution of the firm in 1880, he established himself as their successor, his business being subsequently organized as the John Simmons Company.

No Hurry.

A little difficulty was experienced at N. N. Hill Brass Co.'s iron foundry in running down the heat. The trouble will, no doubt, be straightened out to-day.—Middletown (Conn.) Paper.

Printed Matter for the Trade.

The Cleveland Pneumatic Tool Co., Cleveland, Ohio, are sending out their catalogue of pneumatic tools. It is illustrated throughout with views of the tools in operation.

The David Williams Co., 232-238 William street, New York, have issued "Galvanizing and Tinning," a work on these subjects written by W. T. Flanders. The price is $2.00.

Manning, Maxwell & Moore, 85-89 Liberty street, New York, have just issued a very large and complete catalogue of metal and wood working machine tools and their attachments.

H. S. Vrooman, 220 West 20th street, Chicago, publishes a neat pamphlet describing the brands of fire brick handled by him. In compiling this he has incorporated considerable interesting data concerning fire brick, molding sand and cupola practice.

The Smooth-On Mfg. Co. of Jersey City, N. J., have issued a new booklet of their Smooth-On products, showing illustrations of their application. The Analytical Laboratory of the same company is also mailing to those interested a price list, showing the cost of obtaining analyses of many different materials.

A Greenhorn's Experience.

A few days ago I heard someone remark that various kinds of workmen, as well as sailors, use in their occupations words and phrases, which by an outsider would be no more understood than if spoken in Chinese or Arabic.

This recalled to my mind an incident which occurred many years ago when I was employed as a laborer in an iron foundry at Union City, Conn. On the afternoon of the first day on which I went to work I was sent to one of the molders who, like the others, was on "piece work," to assist at turning castings, none of which, it might be observed, weighed more than four or five ounces. Handing me a long, slim iron poker, bent at one end, the molder told me to separate the castings from the hot sand, place them all together, and let him know if they run.

Congratulating myself at my good fortune in obtaining so easy a job, I took right hold and did the best I knew how; but alas! I soon discovered that I was a novice at the work which I was required to perform.

After dumping three or four cases or flasks, or whatever they were called, the molder, perspiration running off him in streams, took the poker out of my hands and began to investigate the pile, in order to find out the result of my combined efforts. It was at this point the rumpus began, and at this time I regretted I had not served an apprenticeship in an iron foundry, or, to be more truthful, that I had ever set foot inside of one.

With a voice raised to the highest pitch, and swearing worse than an old-time man-o'-war's-man, he inquired, holding out a scrap of metal on the end of the poker: "Didn't I tell ye to let me know if they run? Look at that, and the divil a word ye said about it—divil a wan. What a laddy buck of a helper they sint me!"

In those days I was very sensitive and independent and would not, without resenting it, listen to a word of censure—undeserved censure—from anyone; so with a voice equally as loud and menacing as that of the man whose helper I was supposed to be, I replied: "Run! not a single one of them run; they're all there yet, and if you don't believe me, count them and find out, while I sit down and cool off."

The foreman of the foundry, a jovial young Irish-American, happened to come along in time to hear what was said by both of us, and after laughing himself weak, he turned around to the molder and said: "Look here, Tom! Don't you know this is a green hand—probably never inside a foundry before. Why didn't you explain to him what you meant by 'run'—that you wanted to find out whether your castings were perfect?"

I acknowledged at the time that I did not understand what was meant by the expression, "let me know if they run;" but in justice to myself I must add that I was not quite so green as to believe it possible that inanimate matter could, without outside assistance, creep, crawl, walk, "run" or take unto itself wings and fly away from the place where it had been deposited.

The story, which was quickly circulated around the place, created many a laugh among the workmen; and while I remained I was known as the greenhorn who told one of the molders that not a d—d one of his castings run, that they were all there yet.—Lowell (Mass.) Citizen.

H. W. HOYT

THE NEWLY ELECTED PRESIDENT OF THE NATIONAL FOUNDERS' ASSOCIATION.

Mr. H. W. Hoyt, who has just been elected president of the National Founders' Association, was born in Wisconsin in 1852. He spent his early years upon the farm, and graduated from the University of Wisconsin in 1872, later becoming a newspaper man, and for six years managing editor of the Madison Daily Democrat. From there he drifted to Chicago, where he became connected with P. W. Gates, of the Gates Iron Works, of which establishment he is now secretary and general manager.

Since the inception of the National Founders' Association Mr. Hoyt has taken a great deal of interest in its affairs, having been its vice-president for some time. Possessing the rare combination of good nature, business ability and tact, it is to be expected that the Association, whose affairs he will direct, will rise to greater prominence.